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The Canadian Engineer

A Weekly Paper for Civil Engineers and Contractors

Light Railway Engineering in Modern Warfare

Principles of Construction, Maintenance and Operation — Movement of Supplies, Ammunition and Troops — Different Types of Light Railways Built by French and British Armies — Their Use in Gas Attacks — Inner Rail of Turnouts Slightly Raised

By LIEUT. C. H. R. FULLER
Formerly Assistant Engineer, Toronto-Hamilton Highway Commission

IN the construction of standard gauge railways, highways and canals in Canada and the United States, light railways, in the last few years previous to the war, assumed a prominent part. The wise and energetic contractor or engineer found it cheaper to grade or haul material for his work, directly to the spot required, by light railway than by the old method of teams.

The nearest standard gauge railway siding is sought for, and the light railway laid from this to the work in question. Material is then transhipped and hauled to the work by flat cars or other types adjusted to the light rail.

In grading, the light railway may be laid parallel to the highway proposed or railway, as the case may be, and earth moved from cuts to fills by trains of dump-cars, thus reducing the cost to a great extent. As the work advances, the light railway rails are pulled up and moved ahead, the weight of the rails lending itself to this.

Value Not Realized at First

During the first year of the war the value of light railways was not realized; in fact, the British army, outside the building of a few trench tramways, had practically none at all; however, towards the end of the first year a few light railways were constructed on the Somme by Canadians and Royal Engineers. These lines were mainly lines connecting broad-gauge railways to R.E. dumps for carrying materials.

STANDARD TYPE OF BRIDGE ERECTED BY THE CANADIAN RAILWAY TROOPS

The value of light railways used in the little work they performed during the first year was soon realized. An increase in the number of technical units or construction and operation of this type of railway immediately took place, most of the construction being handled by Canadian railway engineers and operation by Royal Engineers and Australians. Light railways then came into operation on all fronts, and an organization to handle this branch became imperative. A director of light railways for the British army was created; under him, for each army, were assistant directors. Each A.D.L.R. had his own organization for each armmy, which subsequently became as follows:—

A Light Railway Chief Engineer, in charge of construction, etc.; a Superintendent of Operation; an Army Locomotive Superintendent; and an officer in charge of telephones and signals.

BRICK ARCH NEAR COURTRAI BLOWN OUT BY HUNS, TRACKS CURIOUSLY REMAINING INTACT

When a construction unit comes into an army area, they automatically come under the A.D.L.R. for that army, and, consequently, the Army Chief Engineer. An operating company is controlled by the Superintendent of that army.

This organization was brought into a state of greater efficiency by opening up minor appointments in different parts of the work where needed.

Canadian Railway Units were in a corps composed of themselves alone for administration, discipline, etc., under a brigadier-general, but were distributed all along the front under different army A.D's.L.P. for their technical work.

Principles of Supply in an Army

The service of supplies in an army is assured by means of: (a) Supply depots on lines of communication; (b) railway trains; (c) mechanical transport supply columns; (d) trains; (e) supplies carried by transport units and the individual.

Supply depots may be base depots, main supply depots, or field depots. A base supply depot is located at the base of operations to receive supplies from overseas. Main supply depots are placed along the lines of railways or at an advanced base. Field depots are small, temporary depots in the immediate neighborhood of troops.

Troops are supplied with supplies by rail and fast-moving mechanical transport, delivering daily to trains, and thence to troops from railheads. At railheads the supplies are received by the supply columns and conveyed to rendezvous and refilling points. A rendezvous is a spot where representatives of the H.Q. concerned, order the supply columns to refilling points situated in the locality concerned. These are usually fixed at the actual refilling point.

Ammunition differs somewhat from the system of supplies on account of the fact that the replenishment of ammunition is more or less spasmodic, and neither the precise quantities nor the times they will be wanted can be exactly foreseen.

ANALYSIS Traffic Dead Weight Tonnage Standard Weights	SECTION Ouderzeele Tons	Watou Tons	Vox Vrie Tons	Weston Hoek Tons	Total Tons
Personnel	90	1,851	2,322	3,027	7,290
Ammunition	420	1,338	2,342	440	4,540
R.E. stores	1,403	192	814	814	3,233
Timber	36	60	.....	.....	96
Ordnance Stores: Guns					
Supplies	91	70	20	192	373
Coal and coke ...	5	581	105	...	691
Roadstone	.	72	...	...	72
Empty cases ...	.	30	10	103	143
Salvage	.	..	1,350	1,344	2,694
Miscellaneous ..	54	152	180	46	432
Total army traffic	2,099	4,346	7,143	5,966	19,554
Ballast	3,320	2,626	880	163	6,989
Railway material	899	1,003	1,284	600	3,786
Miscellaneous ..	891	342	486	219	1,938
Total traffic	7,847	8,317	9,793	6,948	32,267
Total ton miles..	48,695	58,061	52,840	54,065	*213,661

*Includes 32,267 tons in French System.

The reserves of ammunition are divided as follows: (1) Regimental reserves; (2) artillery brigade ammunition column reserves; (3) divisional ammunition column reserves.

Parks are placed within easy reach of ammunition columns, who carry the ammunition forward. Refilling points may be placed at various distances from the parks to suit the situation.

"Personnel" includes the movement of troops, which is usually carried out by means of standard gauge trains and marches. Motor buses and lorries are also used for quick movements.

Wounded are brought to field ambulance units by ambulances or stretchers from advanced dressing stations and taken to clearing hospitals in ambulances.

Light Railways Supersede Older Methods

Light railways have superseded the supply column to a great extent. All kinds of supplies, such as trench material, steel, sandbags and cement, are carried from the supply depots to the most advanced dumps directly by light railway. Approximately 400 tons of R.E. material may be hauled in twenty-four hours on an army front under ordinary conditions of trench warfare, besides other supplies.

Under ordinary conditions of warfare, contours of country, etc., most ammunition is hauled from refilling points in the back areas to forward area dumps, or else direct to the batteries concerned. For heavy batteries ammunition is often transhipped directly from a railhead to light railways, and hence direct to batteries. These conditions illustrate the amount of labor and handling of ammunition which is done away with by making use of light railways. Many batteries are so situated that it would be impossible to get ammunition into them efficiently by any other way except by a light railway. Main lines are constructed through a battery area, with spurs running into each battery to be supplied. These main lines are connected in the rear by lateral lines and various other back area lines, enabling dumps to be placed out of reach of forward area shelling, although they may be subject to some long range shelling and bombing.

Another advantage of using light railways is the fact that they may be built through the front between roads. Ammunition carried along roads is subject to far heavier shelling owing to the fact that they are usually well marked by enemy batteries. A light railway is hard to range on, and when it is broken, is it very quickly repaired, causing practically no delay.

Within 500 Yards of the Trenches

Two thousand tons per twenty-four hours of delivered ammunition is an average carried by light railways under ordinary conditions. If abnormal battle conditions exist, as much as 5,000 tons may be carried forward.

Light railways are usually built up to within 500 yards of the trenches in the forward area. This enables them to be used also for the transport of infantry, working parties, etc. An infantry battalion going into rest, or a battalion going up to the front, may be brought directly back to approximately the location of their rest billets or taken up to within a short distance from their location in the trenches. This has a great advantage over the long marches "up the line" over roads constantly under shell-fire. Wounded cases are brought back directly to clearing hospitals from advanced dressing stations, which advantage is obvious.

The amount of personnel handled in twenty-four hours by light railways, of course, depends on the character of the front. If an offensive is in operation on one part of the front, more personnel will be carried than on a comparatively quiet front, although it is impossible to carry all the troops in the area and other supplies as well. On the Ypres front in May, 1918, approximately one complete division was carried forward to relieve another division which was carried out of the line back to rest stations, besides carrying on the supply of ammunition and material at the same time. The accompanying table shows the minimum mileage and tonnage figures per week in the Ypres system.

A new use of light railways was brought into use by the cloud gas attack during the end of the month of May, 1918. The method of operation was as follows:—

The object of this gas attack near Ague and Tmulet was to discharge gas at a very high concentration to produce a cloud of gas that would penetrate in lethal strength to a considerable depth behind the enemy's lines. The cloud was estimated to be highly lethal to a depth of 9,000 to 10,000 yards from the point of discharge.

The gas was discharged from trains of special trucks, containing cylinders fitted with an electrical device for opening all cylinders simultaneously. These trucks were conveyed from railway bases to power heads by tractors on the light railway. Forward of power heads, infantry pushing parties, consisting of fifteen parties of twenty men each, pushed the trucks ahead. Each light railway forward line was allotted seventy-five trucks, each containing twenty-one cylinders. The number of cylinders amounted to about 4,725 in all.

The seventy-five trucks were sent up along each line in seven trains of ten trucks and one train of five trucks. The pushing parties, after pushing to the discharge points, were withdrawn to a trench system in the vicinity, where they awaited the completion of the attack. After completion, the pushing parties organized as before, hauled the empty trucks back to power heads by means of 40-foot ropes,

which were used to keep the men away from residual gas. On reaching the power heads the trucks were made up into trains as before and conveyed by tractors back to the railway bases.

Royal Engineers load cylinders into the trucks and provide a sapper to accompany each truck. Maintenance of track was carried on during the attack by Canadian Railway Engineers, who ensured that the track stood the loads required. An adequate supply of material and tools were kept ready to fix breaks due to shell-fire. The importance of this is shown by the fact that due to breakage of tracks by enemy shell-fire the attack was delayed one hour and three quarters, although the track was immediately repaired.

A pilot engine was used to travel in front of each group to avoid every chance of delay by collisions and breaks in track, etc.

In order to carry out this attack, the Light Railways on the day previous had to be closed to ammunition and food supply from 12 o'clock noon onwards. It was arranged that two days' supply would be taken up on a previous day, thus allowing for one day's supply to be used following the night of the gas attack.

Construction of Light Railways

The following types of light railways existed in France during 1918:—

(a) Metre gauge railways.—Weight of steel 451 lbs. per yard.

(b) Light railways, 2 ft. gauge.—Weight of steel 20 lbs. per yard.

(c) French light railways, 60 c.m. gauge.—Weight of steel 9.5 kilos per yard.

(d) Artillery decauville, 60 c.m. gauge.—Weight of steel 9 kilos per yard.

Metre gauge railways were in use in France and Belgium long before the war. The rolling stock is limited and is seldom used except by French and the civic governments. Latterly they were used more extensively.

Light railways are the railways most used in the British army, which we are considering in this article. The gauge is 2 ft. and weight of steel 20 lbs. per yard. In back areas and rear forward areas wooden ties are used. In front areas sectional steel, assembled on steel ties with clip bolts, are used to ensure greater speed in maintenance.

The French light railway has slightly less weight than the English light railway, due to the fact that the French system of standard weights includes the ties, fastenings and both rails.

Artillery decauville is assembled steel on steel ties. It is primarily used for pushing small flat cars about in a battery position and also used for trench tramways in the extreme forward line. Locomotives are not used on it. It is valuable in serving as the connection between the light railway spur and the actual guns.

On Fronts After Advance

On the ordinary stationary front caused by the continual trench warfare, with little variance in the trench line of either side, a system of light railways is quickly built and reaches a point where maintenance and a few extra spurs here and there is the only work carried on; however, an advance by our forces quickly throws the construction machinery into action. Gun spurs, spurs into ammunition dumps, R. E. dumps, etc., then become useless due to the forward movement of batteries, dumps, dressing stations, etc. The main lines must quickly be extended to the forward batteries and spurs built into new positions. New switch lines must be constructed so that no delay occurs in the forward movement. New locomotive and storage yards also must be built forward of their former locations.

After an Enemy Advance

If the advance by the enemy is over considerable territory, necessitating a retirement (for strategical reasons) of the whole army affected, the network of light railways becomes nonexistent and must be relayed farther back to conform to the new front. This was especially the case after the German advance on the Ypres front extending to south of Armentieres in 1918. Every one knows the old military principle that a line of communication must run at right angles to the front line. After the enemy's advance a decided salient was created, causing the line of communication to swing around to the northwest to conform, thus causing the necessity of a large increase in new light railways to be built rapidly to serve new ammunition depots, new refilling points, new R. E. dumps, new workshops, new clearing hospitals, etc.

This causes a feverish activity on the part of railway engineers, who work day and night building up a new system. The light railway line which exists farthest from the front line should be extended to enable all rolling stock, etc., to be evacuated quickly in case of a further advance by the enemy. Lines are constructed running parallel to the new front line caused by the salient. Every consideration is given to running lines to meet standard gauge railways for transhipment purposes. Spurs are constructed to serve ammunition depots, and in the case of the Ypres area it was

BRIDGE BETWEEN LILLE AND BRUSSELS DESTROYED DURING HUN RETREAT—REBUILT BY CANADIAN RAILWAY TROOPS

decided to built light railways in the French army area due to the close co-operation of the two armies at this stage.

When the above work is completed it is thought advisable to construct cross lines to serve reserve battery positions which are constructed in case of another advance by the enemy. Also in the new forward area all locomotive yards and storage yards are dismantled, leaving only the running tracks over the main lines. Any lines which are double tracked and are in the new forward area are also torn up, leaving only a single track. It was at this stage that the French army realized the full importance which was attached to the light railways and many appreciative remarks were made regarding this work. A letter from the general commanding the French army of the north appears on the next page.

On New Fronts

On new fronts devoid of light railways, an entirely new system, both in forward and back areas, must be built up. This will happen in an area taken from a force of different nationality than our own. A system of forward lines to feed batteries and dumps is first considered but not constructed. There may be three to six forward main lines decided on. Then a main back area line is located and built to serve the forward main lines which are then constructed in turn. As the track advances, forward locomotive and storage yards are constructed, spurs built into forward standard gauge lines for transhipment and the usual spurs to serve batteries.

Before an Advance

This is a case of advancing light railways as far as possible towards the trenches and constructing a few new

spurs into advanced dumps established preparatory to the advances.

It was shown in 1918 that light railways could be maintained and constructed ahead of the H.Q. of the infantry battalion in the line. This enables the advance of our forces to be closely followed up by a network of steel and thus assisting their progress by bringing up supporting troops quickly from back areas to the line and delivering rations and ammunition.

In order to carry this out, a railway map of the existing light railway lines in the front under consideration should be consulted. The lines which could be used as main lines and those which could be used as cut-off lines or avoiding lines should be picked out and placed under increased maintenance so that these may be in the best running condition possible at the moment of the advance. As soon as the advance, progresses, if it is successful for

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(Translation)

General Plumer, Commanding,
2nd British Army.

The chief lines making up the new network of 60 c.m. railways, the construction of which was decided last 12th May, have been completed by the British Army in every case very satisfactorily, very quickly, and well constructed.

I have the honor to express to you my very sincere thanks for the co-operation and the valuable aid which is given us also by the 60 c.m. railway construction services of the 2nd British Army.

Remaining yours respectfully,

(Signed) H. de Mitry,

Commander of Detachment of the Army of the North, French Forces.

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any reasonable distance, the lines decided on should be immediately constructed on ahead with the avoiding lines so that ammunition, rations, etc., will follow without delay.

Before an Enemy Advance

The knowledge that an attack on any front is pending is usually gained by information received from prisoners, aerial observation and from our own spies; preparations should then be made in case it is necessary to retire for a short distance as after an enemy advance.

The strictest attention should be directed to light railway bridges the size of which would be sufficient to warrant demolition to cause delay to the enemy advance. These should be mined by means of gun cotton and fuses and sentries posted ready to demolish on receipt of orders from the proper authority.

Surveys, Construction and Maintenance

The principles of surveying and locating standard gauge railways in any country should be made to apply in light railway work. In some armies light railways are not surveyed but constructed only on information gained by a preliminary reconnaissance. This is poor practice and at the present time experience has shown that instrumental surveys and proper preparation of plans and profiles will give better results.

The first step in connection with any proposed light railway line should be to obtain the best available maps of the country in question. Sheets on a scale of 1/20,000 are very useful. On such maps routes may be sketched and a very good idea of the maximum grades of the railway obtained. Routes which are obviously unsatisfactory are eliminated from further consideration. Those that look favorable should be examined by travelling over them. This method minimizes the actual amount of field examination. Grades, curvature, length of time, earthwork and character of soil, bridging and general drainage should be taken into consideration.

Of course, in all consideration of these matters, the serving of R.E. dumps, ammunition dumps, gun positions, A.R.P.'s, etc., should not be lost sight of. The traffic to be accommodated by the proposed light railway may be heavy in one direction and light in the other, in which case a grade of 1 per cent. may not be as serious in one direction as a grade of 0.5 per cent. will be in the opposite direction.

An approximate route having been decided on, a preliminary survey is run, composed of a transit party, level party and an officer in charge. A profile of the preliminary line should be kept up to date during the progress of the survey to give aid in judging whether to push ahead or back up and run the line over different ground. On completion of the preliminary survey the final grade line is decided on and placed on the profile, due regard being given to keeping total quantities of excavations and embankments to a minimum. Long cuttings should be avoided, especially in the forward area. Vertical curves are not used, but short breaks in grade may be decided on to ease, for instance, a level grade connecting a 1 per cent. grade.

Lines should not be located across in front of artillery positions but always in rear when possible. Broad gauge crossings should be 90 degs., 75 degs., 60 degs., or 45 degs. Metre gauge crossings should be made to conform with above angles as nearly as possible. Main lines should not parallel roads closer than 200 yards distance and should be located to serve groups of batteries and not single units.

Plans of proposed lines are plotted on a scale of 200 ft. to 1 in. They should show nature of ground, buildings, roads and other railway lines, streams, the kind of crop and measurements of trees, etc., which may be destroyed. Profiles are plotted on scales of 200 ft. to 1 in. horizontally and 10 ft. to 1 in. vertically. A route map on standard square system must always be prepared to accompany plan and profile. Yard and station plans are plotted on a scale of 40 ft. to 1 in.

Construction by Railway Engineers

Grading.—On authority being received to commence construction, various units should be attached to railway engineers for unskilled labor. Each railway battalion is equipped with a complete set of slush escapers hauled by mule teams, which are used to grade the heavier portions of the line. A level party must lay out the work by means of slope stakes before grading. Quantities must not exceed 3,000 yards a mile. The general principles of standard gauge railway practice should be made to apply to light railways. A sufficient berm must be left between borrow pits and the toe of the embankment. All culverts should be properly bedded to take care of the drainage. Culverts should always be laid at right angles to the line diverting drainage courses where necessary. Concrete 8 ins. and 12 ins., and corrugated pipe 18 ins. and 24 ins. diameter are used.

Bridges.—Where a single span only is required, wood stringers 9 ins. by 18 ins., or 8 ins. by 16 ins., should be used. Wherever the soil is unsuitable, in case of wide spans, pile foundations will be driven by a track driver. A record of driving must be kept, giving penetration measurements.

Bridges should be avoided, if possible, in the forward areas, owing to their vulnerability. Another important point to note is that shore bents are not placed on sills but pile driven invariably.

Track.—Rails of 20 lbs. per yard are used on all lines. Track is laid with staggered or broken joints with nine ties per five metre rail length. If the formation is very soft, this number may be increased by two. Joints are supported and not suspended. In the case of soft formations, 5-in. by 2-in. slabs are laid under the ends of the ties, particularly inside of curves.

Assembled track is laid with even joints and 2,929 steel sleepers per mile. When metre gauge ties are used ,the spacing is 2 ft. 6 ins. centre to centre of the ties. Gauging should be most accurate, especially on curves. Tie plates shall be used, two per tie, on all curves of a lesser radius than 100 metres. Guide rails may be placed where necessary on inner rails.

All turnouts are of 30-metre radius. Where the turnouts are riveted through steel ties, the two rivets tying the check rails to the two centre ties are cut out. The centre

block is removed and check rail jim-crowed, so that the clearance between it and running rail is 1¼ ins. The bolt, if present, is replaced and tightened and the block of wood wedged in between the check rail and the throat of the frog.

In case of unriveted turnouts, the gauge at the nose is exactly 2 ft. and a block of wood inserted between the middle of the check rail and the throat. The gauge throughout the curved part should be ⅜-in. slack, easing off to the heel of the switch in a length of about 4 ft.

In order to facilitate the passage of Baldwin and petrol electric locomotives, a slight raise of the inner rail on turnouts has been found most satisfactory. This is an important point to remember in light railway practice.

The gauge of all curves should be ⅜-in. slack, except where rails are riveted to steel ties, which, of course, cannot be altered.

Four spikes should be used on each tie, two inside, opposite one another, and two outside. On curves, eight spikes per tie should be used.

One-eighth-inch expansion should be left at the joint in each five metre rail length. Experience has shown that no elevation should be put on the outer rail of 50 metre curves. On 30 metre curves a slight super-elevation should be placed on the inner rail. This is done on account of the passage of very slow-moving trains hauled by Baldwin locomotives. One-half inch elevation on outer rail should be applied to curves of 100-metre radius.

Ballast.—Every attempt should be made to obtain ballast locally, particularly from ruined brick buildings. Ballast is also brought in by train. It may be sand or mine earth.

The minimum allowance of ballast per running yard of track is 0.2 cubic yards. The width of ballast should be 6 ins. beyond the end of the tie. The average lift is 6 ins. under the tie, made in two lifts of 3 ins. each, well tamped, two men working diagonally packing under the rail. Earth on no account should be packed on the ballast shoulder, as this stops drainage. A light earth skimming may be thrown on top of light sand ballast to prevent loss through wind storms.

Road and farm crossings should be built as required. Mine earth approaches and an inner platform of four rails inside the running rails and outer guard rails, filled with mine earth well packed, make good crossings.

Reports.—These should be turned in by company commanders to their chief engineer daily and weekly on a standardized form.

Daily reports should indicate the area in charge of the company, number of officers and other ranks employed on the work, including attached labor, also the number employed on each class of work. Work is usually classified as follows: Grading, tracklaying and ballasting, in yards lineal; unloading B.G. cars and distributing L.R. cars, number of cars; dismantling of track, number of rails, ties, etc.; salvage of mine earth, number of cars of light railway.

A separate daily report should show the number of breaks in last 24 hours, on account of shell fire, with time and main locations. Also another daily report should indicate the detail of work by power allotted to the construction unit. Weekly reports should show total grading, ballast, tracklaying, tons of ballast in dumps, amount of track salvaged during week, etc.

Maintenance

Forward Area.—Maintenance in the forward area is probably the most important part of light railway work, where the highest technical skill is required.

It is most essential that forward area lines be intact and in fine working order at all times. Patrols of all lines in charge of an officer of technical knowledge should be placed day and night. The patrol should be able to tell quickly what part of the lines require repair and to be placed under increased maintenance.

Assembled steel is usually used to repair shelled out track quickly. As many as 50 breaks may occur on a line in 24 hours. This will make it difficult for any but highly skilled railway construction men to keep the lines open for operation. Care should be taken that too much attention is not paid to any one section of line when other sections are in need of ballasting and lifting. Gauge of track should be checked continually. A sufficient supply of reserve material should be kept to repair blown-out track.

Forty miles of forward area maintenance may be handled by one company of railway engineers. Five or six petrol tractors should be allotted to each company and about twelve box cars. The line is patrolled by four or five patrols, each travelling by means of a train, made up of a tractor, one box car carrying the personnel, one box car of ballast and one box carrying steel rails, ties, tools, etc. Each patrol has a certain area to keep up. The strength of each patrol depends on the condition of the track in its area and the amount of shell fire and blown-out track.

It is found that the light railway lines lying between the trenches and the battery area require very little maintenance, while the track running through the battery areas requires the most maintenance. Consequently, parts of battery areas should be allotted to all patrols. It is found that spurs to batteries and tracks running along sides of roads are shelled out more than other parts of the lines. Hence, all such track should be carefully examined by patrols.

Back Areas.—The maintenance work in back areas is much different from forward maintenance, since track is very rarely shelled out. The principle of patrols being placed on the lines still exists but not necessarily in the same strength. Ballasting and lining is the principle work carried on. Attention should be paid to spurs which are used continually. Unloading of standard gauge ballast trains should be done by the company in charge of back area maintenance.

Construction of new spurs required is also part of the work of back area maintenance. Civilian labor may sometimes be used as maintenance patrols under supervision of back area maintenance engineers.

Operation of Light Railways

The general organization for operation is a superintendent, a chief traffic officer, central control, district controls and controls in sections.

All traffic matters of operation will be dealt with by the traffic officer. He should be on two telephone systems, with direct telephone. The central control and, under his orders, the district controls, do the actual operation of the line. N.C.O. traffic inspectors are also appointed. These men and a district control officer are forward every night to check up the deliveries.

Traffic priority is usually as follows:—Personnel, rations, heavy ammunition, field ammunition, R. E. material, construction material, wounded and stretcher cases returning home from forward area, unless otherwise stated by control.

Ammunition (heavy) is loaded at the railhead as in field ammunition. This will be labelled "day" or "night" by the railhead ordnance officer, and a copy of this on paper, giving wagon number, number of battery, and light railway group station name is shown. Ammunition marked "day" goes forward by steam power as early as possible by a transfer engine to a selected point. It then goes forward to its destination by petrol power. Ammunition marked "night" goes forward by steam power to a selected point and leaves in convoy at dusk.

Field ammunition goes direct to batteries at night. These trains remain at a selected point during day and go forward by night, using petrol power, as points of delivery are, as a rule, well forward.

The normal train for light railway work at night should, if possible, be five wagons (59 tons), otherwise there is a loss of power. It is more satisfactory to send five wagons for three nights per week, than fifteen wagons one night, or two wagons six nights and three on a seventh.

All engines and tractors should be supplied with re-railing ramps. Maps showing light railways and names of stations should be supplied to all concerned.

The types of petrol locomotives used in the forward area, with their permissible loads, are as follows: Petrol electric, 45 tons; 40 h.p. tractor, 35 tons; 20 h.p. tractor, 16 tons.

Steam power should always be used in the back area, saving the petrol power for forward work. Several points in connection with conservation of power follow:—

(1) In 1918 the value of light railways was better realized than at any previous time. This caused a shortage of power and rolling stock and made necessary the greatest economy.

(2) About 15% of total power and stock available was allotted to construction units for hauling material. Power and wagons not actually required by these units should always be released to operation department.

(3) Locomotives and tractor parts were very scarce.

(4) Shop facilities for making repairs were entirely inadequate.

In view of the above, every care of power and rolling stock was enforced.

Varous operation rules follow here which also apply in forward area:—

(a) Trains should not run by a section control post without securing right of way by a green flag being shown.

(b) Trains should not be allowed to stop in between controls without notifying the control.

(c) Trains should not get right of way to one point and branch off to another.

(d) Loading or unloading on main line should not be permitted.

(e) No wagon bearing a repair label should be put into traffic.

(f) Engine fires should not be drawn in ammunition dumps. Cases of this have caused fires.

(g) Locomotives must not take water at odd places on the main line but at regular watering stations.

(h) Brigade reliefs should have priority over all other trains, personnel or otherwise.

The general analysis in back areas shows haulage of material, rations, etc., from railheads to ammunition refilling points, forward dumps, etc. This material is carried ahead from the forward dumps by other trains as required.

Military Importance of Light Railways

A railway system is a highly sensitive machine, easily dislocated by unskilled treatment. It is at the same time an organism most vital to the maintenance of the army. Subject to considerations of tactical security, the convenience of individual bodies of troops must be subordinated to the efficient working of the line as a whole.

BRITISH INDUSTRIES FAIR

THE British Industries Fair, to be held in 1920, will be limited to firms whose works and head offices are situated within the British Empire, and which are not controlled by foreign interests. In other words, as regards Canada, only such manufacturers as come within this definition will be eligible to exhibit. The fair will be held simultaneously in three different cities—London, Birmingham and Glasgow—representing three distinct sections, grouping various industries. Attention is drawn to the fact that these industrial fairs are not exhibits, but trade fairs, to which admittance is restricted to *bona-fide* buyers, seriously interested in the participating trades, and that admission is by invitation only, the general public being excluded. A preliminary event open this year for a period of eleven days drew an attendance of 17,600, and the authorities state that it resulted in the placing of orders amounting close on to $10,000,000, thus indicating the importance of the Trade Fair for which arrangements are now being made. Canadian manufacturers who are desirous of securing exhibit space or more complete particulars should communicate with the following British government trade commissioners:—G. T. Milne 367 Beaver Hall Square, Montreal; F. W. Field, 260 Confederation Life Bldg., Toronto; or L. B. Beale, 610 Electric Railway Chambers, Winnipeg.

MORE DISCUSSION ON LEGISLATION

WHEN is an engineer not an engineer? That seemed to be the main question at a special meeting of the Toronto branch of the Engineering Institute of Canada, held June 12th, at the Engineers' Club, Toronto. The answer, claimed the younger members of the branch, is, "When he is an assistant engineer."

The meeting was called by special request of the younger members of the branch, to continue the discussion on the draft of the proposed legislation which will be sought by the Engineering Institute in order to close or partially close the engineering profession.

Clause 7i, dealing with assistants working under professional engineers, was the one to which objection was taken by the younger members. J. C. Krumm thought that if the bill were passed in its present form it would mean that no engineers other than chiefs of departments would be considered as professional engineers.

H. A. Goldman strongly defended the professional standing of salaried engineers who report to superiors, and complained regarding the injustice the bill would do to the professional standing of these men.

Frank Barber thought that the bill in its present form does not exclude all salaried engineers from being considered as professional engineers.

Willis Chipman read several letters from other members of the legislation committee stating that undergraduates cannot expect to be considered as professional engineers immediately upon graduation. Among others who took part in the discussion were E. T. Wilkie, F. B. Goedike, C. S. Gzowski and Major H. N. Gzowski.

It was moved by J. C. Krumm and seconded by Frank Barber that a committee of five members be appointed to consider carefully the draft bill in detail and to submit recommendations to a general meeting to be called at a later date. This motion was carried and the following members were appointed to special committee:—

Willis Chipman (convenor), Prof. H. E. T. Haultain, Thomas Hogg, J. C. Krumm and H. A. Goldman. This committee will meet weekly until its work has been completed.

ACCELERATION OF CONCRETE HARDENING

AS the result of some experiments made by the U.S. Bureau of Standards to develop a method to accelerate the rate at which concrete increases in strength with age, it was found that the addition of small quantities of calcium chloride to the mixing water gave the most effective results. A comprehensive series of tests was inaugurated to determine further the amount of acceleration in the strength of concrete obtained in this manner, and to study the effect of such additions on the durability of concrete and the effect of the addition of this salt on the liability to corrosion of iron or steel embedded in mortar or concrete. The results to date indicate that in concrete at the age of two or three days the addition of calcium chloride up to 10 per cent. by weight of water to the mixing water results in an increase of strength over similar concrete gauged with plain water, of from 30 to 100 per cent., the best results being obtained when the gauging water contains from 4 to 6 per cent. of calcium chloride.

Compressive strength tests of concretes gauged with water containing up to 10 per cent. of calcium chloride, at the age of one year, give no indication that the addition of this salt has had deleterious effect on the durability of the concrete.

At a recent meeting of the Engineering Council of the United States, Chairman Loweth, of the Committee on International Affiliation of Engineers, presented a verbal report to the effect that a few weeks previously he had visited Vancouver and met five or six prominent engineers, who were receptive to proposals for activities that might be of common interest.

MOVING 60-FT. OIL STORAGE TANKS 150 MILES BY WATER

By A. J. T. Taylor
Manging-Director, Taylor Engineering Co., Ltd.

EARLY in 1918 the Powell River Co., operating a very large paper mill at Powell River, B.C., were faced with the necessity of immediately providing additional fuel oil storage capacity of 45,000 barrels to accommodate the last cargo of fuel oil that they expected to be able to obtain from the California fields during the duration of the war.

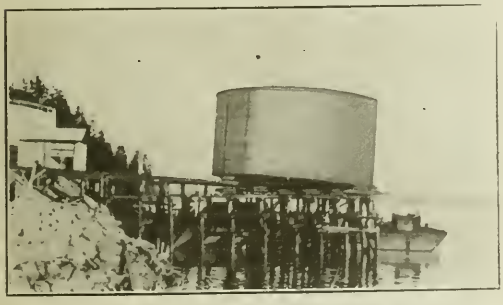
The matter of providing this storage was placed in the hands of the Taylor Engineering Co., Ltd., of Vancouver, who upon investigation found that not only was the price of steel tank plate very high, but it was impossible to obtain the necessary plates within the desired time.

Tanks in Original Position at Bamberton

Concrete storage tanks were considered, and it was found that a tank of the capacity of 45,000 barrels would have cost in the neighborhood of $60,000.

The situation appeared almost hopeless until it was discovered that the Associated Portland Cement Co., at Bamberton, B.C., had three 15,000 barrel storage tanks that they were not using, and were willing to sell. These were purchased on the foundations, as they stood at Bamberton, for approximately $24,000.

The question of transferring these tanks from Bamberton to Powell River was next tackled ,and it was at first thought that the only way of doing this would be the usual method of cutting the tanks down and re-erecting them. It was then found that, due to the large program of the Imperial Munitions Board for the construction of wooden and steel

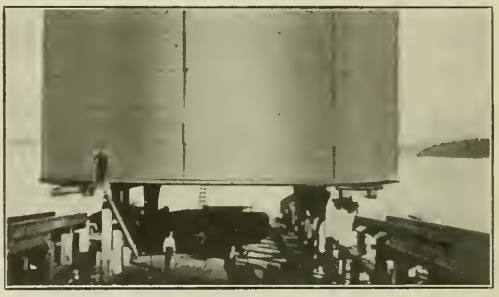


Scow Moving into Position Under Tank

vessels in the neighborhood of Vancouver, there were only three or four boiler makers available, and only one of these who had any experience in tank work. In other words, it was practically impossible to ge an adequate supply of labor to cut down and re-erect these tanks.

First Tank Loaded and Leaving Bamberton

Therefore, it was determined to move the tanks in one piece after calculations had been made to determine the stability of each tank when mounted on a 30-ft. by 40-ft. scow. Two lines of piles were driven at Bamberton opposite the point at which the tanks were located. The tanks were lifted from their foundations by means of jacks, and set out over the water at a sufficient distance above the water so that the scow could be run in between the lines of piles at low tide, and after the tide came up, each tank would settle



Tank at Foot of Incline, Powell River

on the scow and the scow and tank be pulled free of the trestles.

It was thought desirable to brace the tanks internally to eliminate so far as possible the strain that they would be subjected to in their journey from Bamberton to Powell River, and the method finally adopted was to drill a 2-in. hole in the centre of the bottom of each tank, and in this hole mount a shackle from which was set up a series of turnbuckle guys from the top edge of the tank to the shackle, the structure of each tank being depended upon to prevent the sides being pulled in by the strain on the turnbuckles.

Ready to Haul up Incline at Powell River

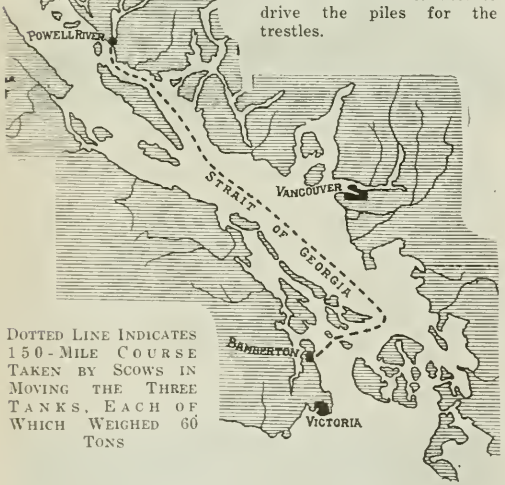
Each tank, after it was floated onto a scow, was towed approximately 150 miles to Powell River, at which point four lines were driven, and between each pair of lines a space was left that would admit the scow. From the landing platform double tracks were extended up approximately 800

THE THREE TANKS IN FINAL POSITION AT POWELL RIVER

ft. to the final location for the tanks, these tracks being spaced so as to accommodate standard-gauge tracks.

The scow was floated between the trestles, which were at such a height so that at high tide there was ample space between the bottom of the tank, as it projected on each side of the scow, to enable the railway trucks to be run underneath, and as the tide lowered it left each tank supported on the trucks.

The tank was then hauled up the inclined runway to the foundation that had been prepared by means of a 7 by 10 double-drum engine that was installed on the pile driver that had been used to drive the piles for the trestles.



DOTTED LINE INDICATES 150-MILE COURSE TAKEN BY SCOWS IN MOVING THE THREE TANKS, EACH OF WHICH WEIGHED 60 TONS

The three tanks were unloaded and the job completed within thirty days at a total cost of $14,000, which was nearly $5,000 lower than the lowest tender had received from local iron works for cutting down and re-erecting the tanks. The total cost to the Powell River Co. of the three tanks complete was $38,650.

The tanks when loaded on their final foundations and tested, were found to be absolutely free from leaks,—evidence that they were not seriously strained in the moving operation.

AGENTS FOR ROBERTS FILTER MFG. CO.

ANNOUNCEMENT has been made of the appointment of E. J. Philip & Sons, Hamilton Trust Bldg., Toronto, as agents for Ontario for the Roberts Filter Mfg. Co., of Darby, Pa. Mr. Philip returned to Toronto last February after having spent two years in Porto Rico as resident engineer for the Roberts Filter Mfg. Co. on American government business in connection with emergency water supplies. Previous to his connection with the Roberts Co., Mr. Philip was manager at Brockville, Ont., of the gas, electric light and waterworks departments, and had previously held a similar position at Kitchener, Ont., where for seven and a half years he had been manager of the gas, electric light and street railway services. Prior to moving to Kitchener, he spent seven years as mechanical and electrical engineer for the T. Eaton Co., Ltd., Toronto. The Roberts Co. have been represented in Canada for some years past by Smiley Bros., of Edmonton, who will continue to have the agency for Albert and Saskatchewan, and by Arsenault & Plamondon, of Montreal, who will continue as the Quebec representatives.

PUBLICATIONS RECEIVED

TRAUTWINE, THE CIVIL ENGINEER'S POCKET BOOK.—First issue of the twentieth edition, published by the Trautwine Co., 257 South Fourth St., Philadelphia. Canadian selling agents, Renouf Publishing Co., Montreal. 1,528 pages, 4 by 6½ ins., flexible cover. Price, $5 net. This new edition of this well-known and popular work was reviewed in advance in some detail in *The Canadian Engineer* for April 10th, 1919.

The Dominion Tar and Chemical Co., Ltd., have moved their Toronto office from the Bank of Hamilton Building to larger premises at 400 McKinnon Building, Melinda St. Their new telephone number is Adelaide 3827.

At the good roads convention in Quebec, T. Harry Jones, city engineer of Brantford, Ont., discussed Mr. Breed's paper on the use of concrete in roads, bridges and culverts. Referring to the tests described by Mr. Breed (see *The Canadian Engineer* for May 29th, 1919), Mr. Jones said that they were most valuable in concrete road work from a pioneer standpoint, as the machine had the same effect on the pavement as the caulks of horses' shoes. If proper methods are used in their construction, said Mr. Jones, there is no doubt about the absolute satisfaction that will be given by concrete roads. He inquired from Mr. Breed why fourteen days should be stated as the period which should be allowed to elapse before a newly completed concrete road is opened to traffic. Mr. Jones said that he could understand why seven days should be allowed to elapse, but he wondered whether there was any scientific basis upon which fourteen days were fixed. He had known engineers who claimed that two days were sufficient. Mr. Jones also referred to the longitudinal joints, which he said he had tried and found satisfactory. In replying, Mr. Breed said that he did not know of any scientific data upon which the fourteen day period was based. Some engineers say that seven days are sufficient, while others say that it is not safe to open the road to traffic even in fourteen days. In order to harden the concrete more rapidly, a 4% solution of calcium chloride had been used, thus increasing the strength of the structure, and after seven days with this treatment, the increase in strength of the pavement was approximately 20%. Mr. Breed called attention to the fact that longitudinal joints should be continued up into the new material when resurfacing a road. In regard to transverse joints, he said that New York had spaced them at various intervals from 25 to 150 ft. and that no definite conclusions had yet been arrived at as to the best spacing, as the state had been experimenting along these lines only three or four years and it was impossible yet to arrive at any definite conclusion.

WATER WORKS SITUATION AT TORONTO

Consumption is Increasing and Additional Filtration and Pumping Capacity May Soon be Required—Works Commissioner Favors New Construction

DESPITE the new ver Mehr filtration plant, the city of Toronto is said to have insufficient filtration capacity for its present requirements. R. C. Harris, commissioner of works, has admitted that a certain amount of raw water had to be let through the mains recently because the combined capacity of the old slow sand filter plant and the new ver Mehr rapid sand plant was insufficient.

The slow sand plant is rated at 48-million gallons daily capacity and the ver Mehr plant at 60-million, so that on paper the city has 108-million gallons daily capacity, but it is only on paper, as the slow sand plant cannot filter with maximum efficiency more than 36-million gallons daily, as part of the plant is always "out" for cleaning, while the ver Mehr plant has had one or more units out of commission most of the time for one cause or another.

Difficulty with the Throats

The chief difficulty in connection with the ver Mehr plant has been the throats on the sand washers, which have been cut rapidly by the sand and water, and which have had to be constantly repaired and replaced. It is understood, however, that a heat treatment has been devised that is producing satisfactory results in these throats, and that the ones produced by this new process are lasting much longer. All of the units are now being equipped with these heat-treated throats.

Upon inspection of the plant a couple of weeks ago, *The Canadian Engineer* found that three of the ten units were out of commission. One was out on account of repairs to the throats, and another for other necessary repairs. In the third unit all of the sand had been removed and a layer of fine graded gravel, mixed 1 to 15 with portland cement, was being laid over the coarser gravel. It was stated that this was being done as an experiment to see whether it would hold down the coarser gravel, as trouble had been experienced during the back-washing with gravel being shot up into the sand.

Referring to the general situation, Works Commissioner Harris is reported to have said: "I can only say what I have said for years, and that is that the situation will never be satisfactory until we have a duplicate plant."

When he presented his plans in 1913, for a new filtration and pumping plant to be located at the east city limits (Victoria Park), the cost mentioned was $6,033,700, including nearly $2,400,000 for 32 miles of distribution mains. What the cost would be to-day is not known, but it would certainly be much higher. Some of the new mains have already been constructed, however.

In the two filter plants at the Island, Toronto has invested nearly $2,000,000.

Pumping Station Nearing Capacity

The main pumping plant is also nearing its capacity. The capacity of the steam pumps at the John St. station is 102-million gallons, daily, but on account of repairs, etc., the average pumping capacity is often not over 78-million gallons. There are electrically-driven standby pumps of 88-million gallons capacity. As the maximum consumption has reached the rate of 90-million gallons daily (for a portion of a day only), part of this must be supplied by the reservoir. The consumption during the recent very hot weather was at times 78-million gallons daily.

As all Toronto's water, whether filtered or raw, is effectively chlorinated, there is no danger of an epidemic, says the health department. In fact the department announces a new low record in typhoid mortality in Toronto, there having been only three deaths from that disease during the present calendar year, and two of those cases originated outside of the city. This is largely due to the fact that no expense is spared in treating the water whenever it is in a dangerous condition. When there is an east wind, endangering the supply on account of the sewage outfalls, three grains of alum per gallon of water are used at the new filtration plant, and the amount of chlorine fed at John St. is also increased.

The alum consumption for the month of May averaged over two grains per gallon. For a time chlorination was tried at the Island, ahead of filtration, as well as after filtration at John St., and it was thought that by chlorination ahead of filtration the amount of alum required would be reduced. Although this was found to be the case, the Health Department objected to the two chlorinating plants on account of division of responsibility, and the Island plant was recently removed and the chlorinating again centred entirely at John St.

The only chlorinating plant at Toronto Island now is a small unit for chlorinating the supply for the Island itself, and it is connected into the suction of the pump that supplies the services on the Island.

It is rumoured that before asking any further money for the extension of filter plants or the construction of new pumping stations, the Works Commissioner will eliminate all underground leaks by means of thorough pitometer surveys, and that he will also recommend the reduction of waste in houses and industrial establishments by the metering of all services, both domestic and industrial. It is well-known that nearly all of the city officials are keenly in favor of meters and also of constant surveys for underground and other leaks. A few years ago a very successful pitometer survey was conducted in Toronto, and this work is most likely to be taken up again in the near future, as the daily average consumption per capita is about 120 gallons and has at times probably exceeded 150 gallons.

PROGRESS BY ENGINEERING COUNCIL'S COMPENSATION COMMITTEE

REPORTING at the recent regular meeting of the United States Engineering Council, the committee on classification and compensation of engineers presented the following analysis of the situation:—

"In attempting to formulate standard rates of compensation for professional engineers, the first task is to find what rates are actually in force, especially in those fields where attempts at standardization have been made. The second task is to inquire what adjustment should be made to correspond to the great change which has taken place in the cost of living, or, in other words, in the value of the dollar. How great this change has been during the past 20 years is realized by few. Fortunately, an accurate determination is available in the statistical records of average prices which for many years have been gathered and published by leading commercial organizations.

"A record of average prices of the necessaries of life kept by R. G. Dun & Co., shows that prices have increased continuously for 22 years. A certain quantity of staple necessaries could have been purchased July 1st, 1897, for $72.45. By January 1st, 1905, the same quantity cost $100.32. On January 1st, 1914, before the outbreak of the war, the cost had risen to $124.53; May 1st, 1917, to $208.43, and October 1st, 1918, to the maximum of $233.23.

"This enormous increase in prices of the necessaries of life has been accompanied by an increase in wages, especially among workers organized in unions which had the power to compel attention to their demands. In the unskilled labor market the relations of supply and demand raised wages during the war to points in some cases exceeding the increase in the cost of living. No such increase has taken place in the compensation of salaried workers in the professions. It has been assumed that these workers, living in a different social environment, had a margin of compensation sufficient to enable them to meet the increased cost of living. This assumption is not justified by the facts. Where salaries have been increased during the past three years, there are few cases in which the increase has been at all commensurate with the increase in prices of the necessaries of life, which the salaried worker, like the wage worker, has to purchase. That this is a correct statement

is amply proved by many direct comparisons which have been made of the wages of the workers in various skilled trades and the salaries of the rank and file of technical and professional workers.

"There is little doubt that an unprejudiced investigation would show that a large proportion of the salaried workers in professional occupations during the past three years have been unable to pay their living expenses from their earnings and have been obliged to rely on income from property owned or to use up savings of other years in order to maintain themselves.

Present Prices Here to Stay

"A serious question is whether the present scale of prices is here to stay. There has been a general belief that with the coming of peace and the resumption of productive industries a heavy fall would occur. It has been assumed that the salaried worker would have to wait for this so that he could again live within his income. It now appears, however, to be the opinion of many financiers and economists that the present high prices of necessaries are likely to continue for a long time, probably for several years. The salary of $2,000 a year which a man received from 1902 to 1905, will now buy less than $1,000 worth of necessaries. This has been the case for two years. If this is to continue for two, three or four years to come, then surely the salaried worker, in a professional or any other occupation, has an equitable claim to have his compensation brought back in purchasing power to where it was fifteen years ago.

A Gross Deception

"There is another aspect of the compensation of the professional worker which has been frequently misunderstood, but which, with present knowledge, ought no longer to deceive. The pay of professional engineers has for many years been influenced by the idea that a young man in the earlier years of his work should expect moderate compensation because of the future to which he might look forward. In Great Britain this idea found expression for many years in the custom of the young engineer paying a premium during a number of years' service in order to learn the business. There was justification for this idea during the period when the development of engineering was so rapid that a large proportion of the men who were turned out from the few engineering schools or the engineering workshops were able eventually to rise to positions of large responsibility and importance, commanding high salaries.

"That condition has been altered. Of the men who begin technical engineering work to-day, only a very few selected ones can rise to positions of responsibility commanding high salaries. The rank and file must inevitably be ten times as numerous as the captains and lieutenants, and a hundred times as many as the majors and generals.

"The man of exceptional ability, indeed, may find it worth his while to work for low compensation because of the future awaiting him. But to hold up to the rank and file of technical workers the idea that they can afford to work for insufficient salaries for the sake of some future high position, which they have not one chance in twenty or fifty of attaining, is a gross deception.

In Public Interest that Engineers be Well Paid

"The committee believes, therefore, that in adopting standards for the compensation of workers in all technical fields, due consideration must be given to the great increase in the cost of living which has taken place. The dollar of salary must be considered with regard to what it will purchase to-day and is likely to purchase next year, and not with regard to the value of the dollar ten or fifteen years ago.

"This increase in compensation is necessary, not merely as a matter of justice to the engineer, but in order that engineering work may be maintained on the plane that it must be to secure economical and efficient work. Not only the leaders but the rank and file of technical workers often have it in their power largely to affect the cost of the work in their charge by the quality of the effort they exert."

WATER EXPECTANCY IN TUNNELS, MINES AND DEEP WELLS IN HOMOGENEOUS ROCKS*

By Robert E. Horton

IN planning deep subsurface structures such as tunnels and mines, it is desirable to form some idea in advance as to the amount of water which will probably be encountered and will require removal. Isolated test shafts are costly, and may not show average conditions. It is desirable to supplement such special data by considerations based on general experience as to the yield of underground water under similar conditions.

Data can generally be secured as to the yield of shallow or surface wells overlying the region where the underground structure is to be made. Such data have been published concerning many conditions and kinds of rock as to the average and usual range of yields of surface wells under different conditions.

It is the purpose here to present a method and formula by which data obtained from surface wells can be applied, under suitable conditions, to the estimation of the amount of water which it may reasonably be expected will be encountered in any deep excavation.

The method is limited to cases where the bed rock is somewhat uniform in character throughout all depths from the rock floor down to the bottom of the tunnel or other structure. For example, the method will apply to the estimation of probable water in a tunnel in granite, which extends to the surface, but will not apply to a tunnel in deep-seated granite overlain by thick beds of sedimentary rocks.

Without giving details it may be said that there are physical reasons, well confirmed by statistics and experience, showing that the frequency and water-carrying capacity of fissures, joint openings and solution channels in rocks decreases rapidly as the depth increases.

Assuming, for simplicity, and as fairly representing experience, that the water-yielding capacity of a given kind of rock varies inversely as the depth, and that q is the maximum yield per sq. ft. of surface at a depth 0 to 1 ft. below the water table. The quantity q corresponds to Slichter's "transmission constant" and its value can be determined from the measured yield of shallow wells in the given location and kind of rock. Then the yield per sq. ft. of surface at a depth h below the surface of the water table may be expressed by the equation

$$q_h = q'h \qquad (1)$$

The total yield from one side only of a vertical surface one foot wide intersecting the water bearing rock from a depth h_1 to a depth h_2 will be to

$$Q' = q_1 \int_{h_1}^{h_2} dh\ h \qquad (2)$$

If p is the ratio of the perimeter of a tunnel to its height, or the ratio of the perimeter of a well to its diameter, then letting Q_1 equal PQ', where Q_1 is the total yield of a horizontal tunnel per ft. of length, or the total yield of a well between any chosen depths per ft. diameter, there follows by integrating

$$Q_1 = q_1 p\ (\log_e h_2 - \log_e h_1) \qquad (3)$$

If it is desired to determine the total yield of a well from surface to bottom, h_1 should be taken as unity to correspond to the conditions assumed in fixing the value of q_1.

As a practical example, statistics gathered by E. E. Ellis, M. L. Fuller and others show the average yield for numerous shallow wells, on steep, rocky areas, in granitic gneiss and schist of southeastern New York and Connecticut, to be about 4 gals. per min. for 6 in. wells with an average depth in rock below the water table of about 150 ft. The perimeter of a 6-in. well is 1.54 ft. and the corresponding rate of yield for a flat surface 1 ft. wide and 150 ft. deep would be 2.60 gals. per min. Solving (3) for q_1 under these conditions:—

$$q_1 = 2.6 \log_e 150 = 0.52 \text{ gals. per min.}$$

*From the Journal of the American Water Works Association.

It should be noted that only wells with little cover of sand or other unconsolidated material have been considered in selecting the value of Q_1 to determine q_1. Shallow wells in rock but with deep cover of loose material often receive much of their supply from above the rock, and may indicate water quantities in excess of the transmission capacity of the rock itself, even at the surface where it is most fissured.

Let it be required to determine the amount of water that will probably be encountered in a tunnel 15 ft. high and with 60 ft. perimeter, at an average bottom depth of 250 ft. below water table in granitic gneiss and schist, the length of the tunnel in rock being 11,000 ft. Using the value of q_1 above determined, and solving (3)

$$Q_1 = 0.52 \times 4\ (\log_e 250 - \log_e 235) =$$

0.135 gals. per min. per ft. of tunnel.

Let Q equal the total infiltration to the tunnel, the length being L. Then $Q = Q_1 L = 1485$ gals. per min. This indicates that provision should be made to dispose of 1485 gals. per min., or something over 2,000,000 gals. per day.

Experience in constructing the tunnel for which data are above given showed an average yield for some time of 1,000,000 gals. per day, and larger yields at times, approaching the amount above calculated.

Like most hydrologic methods and formulas, this one is not infallible, and its application requires intelligent discrimination in selecting surface-well data to determine q_1. It is intended to apply to fissured rocks such as granites, trap, basalt, gneisses, schists, and sometimes limestones and dolomites. It is possible that a large water vein may be encountered which will greatly increase the yield, but the probability of this decreases with increased depth.

In the case of unconsolidated materials and sandstones, the water transmission capacity may decrease little or none with increased depth, and formula (3) does not apply. The quantity of water obtainable from such deposits by means of wells, tunnels and infiltration galleries can be calculated by existing formulas given in various books on water supply.

In the case of shales, experience shows that the water-bearing fissures decrease very rapidly with increased depth, in fact little or no water is generally obtained in dense shales at depths more than 50 to 100 ft. below the rock floor. Observations by the author in the case of many deep wells in Hudson River shale as to the relation of depth to yield is fairly represented by the formula

$$Q_1 = 2 q_1 p\ [(1/h_1) - (1/h_2)] \quad \ldots\ldots\ldots\ldots\ldots\ldots\ (4)$$

This is derived on the assumption that both the number and size of connected fissures in shale decrease as the depth increases, or that the transmission capacity per unit of surface varies inversely as the square of the depth. For example, if a 6-in. well extending 20 ft. below water table in shale yields 6 gals. per min., then solving for $q_1 p$ in (4) by taking $h_1 = 1$ and $h_2 = 20$

$$q_1 p = 6/2\ (1 - 1/20) = 3.15$$

To find how much the yield of this well will be increased by extending it to a depth of 100 ft., we have from (4)

$$Q_1 = 6.30 \times (1 - 1/100) = 6.24$$

The yield of the well would be increased ¼ gal. per min. by extending it from 20 to 100 ft. depth.

The formula indicates that half the water obtainable will be found in the first foot of depth in shale rocks.

This result is certainly of the right order, since experience shows that nearly all the water obtainable in Hudson River shale is often found within 5 ft. below rock surface. A number of wells to depths of over 1,000 feet in shale in the vicinity of Albany, N.Y., afford their entire yield very near the surface and refute the popular belief that water can always be found in abundance if only a well is drilled deep enough.

Formula (3) can be applied in a manner similar to (4) to determining the probable increase of yield with depth for wells in granite, etc., and indicates little expectancy of increased yield at depths exceeding a few hundred feet, which also is verified by experience.

Formulas (3) and (4) are intended more especially for application to tunnels and mines rather than to wells, since the surface area of ground water interception in the case of the former is much larger and will generally approximate average conditions more closely than for isolated wells.

EFFECT OF THE WAR UPON WATER WORKS' REVENUES AND EXPENSES*

By Leonard Metcalf
Consulting Engineer, Boston, Mass.

THE situation with regard to the water works of the United States is probably fairly shown by the accompanying comparative records of about 50 plants with aggregate annual revenue of about $35,000,000 and supplying a total population of upwards of 9,000,000 persons, or nearly 9% of the entire population of the United States. The data for 1914-17, were presented to the association a year ago by its committee on war burdens of water works. The 1918 figures have been collected and added by the writer. These records indicate that:—

1. The annual revenues with such increase in rate schedules as were granted by the regulatory authorities and put into effect by the plants, have increased at an average rate of approximately 7% per annum, slightly less than a normal amount.

2. The operating expenses, including taxes where taxes are paid, and excluding them where none is paid, have increased over the year 1915, abnormally, by 13% in the year 1916, 33% in the year 1917, and 52% in the year 1918.

3. The net (operating) revenues applicable to depreciation, interest, dividends and surplus, have substantially stood still since the year 1915.

Table I.—Comparative Water Works Revenue and Expense, 1914-1918, in Percentages of 1915

Group.	1914.	1915.	1916.	1917.	1918.
Percentage Gross Annual Revenue.					
Eastern	95.7	100	110.1	112.8	120.6
Central	98.3	100	109.1	111.4	126.4
Southern	97.7	100	107.5	120.3	126.3
Western	101.7	100	107.3	109.5	117.5
Average	98.3	100	108.5	113.5	122.7
Percentage Operating Expenses, Including Taxes.					
Eastern	99.7	100	121.9	141.1	149.7
Central	100.9	100	109.3	137.3	162.3
Southern	97.0	100	109.7	134.6	166.9
Western	98.6	100	109.9	117.4	128.0
Average	99.0	100	112.7	132.6	151.5
Net Revenue Applicable to Depreciation, Interest, Dividends and Surplus.					
Eastern	90.9	100	103.0	90.4	105.8
Central	97.3	100	110.0	98.5	106.6
Southern	97.9	100	96.3	104.0	89.1
Western	103.6	100	104.3	105.3	114.4
Average	97.4	100	103.4	99.6	104.0

The average increase in population in this country has been at the rate of approximately 1.9%, compounded annually, and of the cities supplied by these 50 typical water works, about 3.1%.

The net revenue of water works usually increases at the rate of from 4% to 5%, compounded annually. Yet the total increase in the three-year period from 1915 to 1918, is but 4%, against a normal amount of from 12% to 15%, in spite of increases granted by the commissions.

The records gathered indicate further that the increases in rates granted to water works by the commissions seem to have amounted on the average to about 10%, serving thus to decrease the loss in net revenue in the year 1918, from 20%, more or less, to 10% or thereabouts. If this inference is sound, the loss in operation was divided equally between the works and their consumers.

It is clear, however, that the burden of increased operating expenses, plus the interest upon the new investment put into these properties during the war period, has been *borne by their owners*, in larger measure than by the public, except in the case of publicly owned works.

Unskilled Labor Costs, in cents per hour (see Table II.) did not generally feel the influence of the war until the middle of the year 1916. As compared with pre-war conditions,

*Read last month at the Buffalo Convention of the American Water Works Association.

TABLE II.—INCREASE IN COST OF LABOR AND MATERIALS TO WATER WORKS IN THE UNITED STATES, AS REPORTED TO THE EXECUTIVE COMMITTEE OF THE AMERICAN WATER WORKS ASSOCIATION, MAY, 1918, AND REVISED, APRIL, 1919

Item.	Number of Records	Prices per Unit				Per Cent. Increase over 1915			Year 1918		
		1915	1916	1917	3 Mos. 1918	1916	1917	3 Mos. 1918	No. of Records	Unit Price	Per Cent. Increase Over 1915
Unskilled labor* in cents per hour:											
(a) Western Group	7	27.0c.	28.5c.	31.4c.	Still	5.0	16.0	Still	8	41.8c.	54.7
(b) Central Group	12	21.7	25.3	26.9	increasing	17.0	24.0	increasing	10	37.2	71.3
(c) Eastern Group	15	23.0	26.7	30.4	in 40.6%	16.0	32.0	in	18	40.2	74.7
(d) Southern Group	10	17.9	20.6	24.5	of all	15.0	37.0	all	12	34.3	91.6
(e) Average of Groups (4)	..	22.4	25.3	28.3	groups	13.0	27.0	groups	4	38.4	71.2
(f) Average of all	44	22.1	25.2	28.3	.....	14.0	28.0	.....	48	38.4	73.2
Cast-iron pipe, per 2,000 lbs.	21	$24.23	$30.70	$51.60	.....	26.7	112.9	.....	..	$67.74	179.0
6-inch valves	11	11.18	12.64	19.13	$23.20	13.1	71.1	107.6	23	19.13	71.0
12-inch valves	3	34.78	41.53	65.22	69.00	19.4	87.6	98.7	10	65.02	87.0
Two-way hydrants	6	26.69	32.04	43.13	53.90	20.1	61.6	102.0	38	5.80	94.0
Coal, per 2,000 lbs.:											
(a) Eastern Group	13	$2.98	$3.80	$5.96	$7.04	27.5	100.0	136.3	16	6.00	101.0
(b) Central Group	11	2.41	2.77	3.75	6.38	14.9	56.4	164.7	10	4.53	88.0
(c) Southern Group	12	1.92	2.01	3.03	4.02	4.7	57.8	109.4	10	3.89	102.0
(d) Western Group	5	3.97	4.37	6.31	7.89	10.1	58.9	98.7	6	7.92	99.0
(e) Average of Groups (4)	..	2.82	3.24	4.77	6.33	14.9	69.2	124.4	4	5.57	97.0
(f) Average of all	41	$2.62	$3.04	$4.52	$5.69	15.3	73.7	117.1	42	$5.42	107.0
Fuel oil, cents per gallon—South	1	1.80c.	1.80c.	2.00c.	4.50c.	0.0	11.1	150.0	1	4.28	138.0
Fuel oil, cents per gallon—West	1	1.38	1.50	2.57	3.55	8.7	86.2	157.3	4	4.05	193.0
Alum, cents per pound:											
(a) Western Group	2	1.14c.	1.21c.	1.51c.	.....	6.1	41.4	.....	3	1.53c.	34.0
(b) Central Group	5	0.91	0.91	1.25	.....	0.0	37.0	.....	6	1.50	65.0
(c) Eastern Group	9	1.12	1.72	1.48	.....	54.0	32.7	.....	8	1.46	29.0
(d) Southern Group	9	1.08	1.38	1.48	.....	28.0	37.0	.....	9	1.78	65.0
(e) Average of Groups (4)	..	1.06	1.30	1.43	.....	23.3	35.1	.....	4	1.56	47.0
(f) Average of all	25	1.07	1.40	1.44	.....	30.6	34.4	.....	27	1.59	49.0
(g) New York market price†	Average of Monthly Prices	2.08	4.63	3.57	5 Months 3.15	123.0	71.6	51.4	..	....	....

*Note. It was generally reported that there has been also a marked decrease in efficiency of labor since 1914, variously estimated at between 20% and 50%; and that the increase in wages paid to labor by water-works had not kept pace with contract prices, owing probably to the advantage of continuity of service.

†See "Journal of Industrial and Engineering Chemistry." Note that 1915 price was an advance of 34% over the 1914 average price before the advances listed went into effect.

reflected by the prices prevailing in 1915, they increased one-eighth in 1916, one-fourth in 1917, and nearly three-fourths in 1918. The increase was felt most markedly in the south and upon the eastern seaboard, being nearly doubled in the first, and increased by three-fourths in the latter district. The wages paid upon the Pacific coast before the war, which were much higher, have advanced relatively less than elsewhere, so that at the present time the eastern and western unskilled labor prices are about the same. Thus the average rate in the western group increased from 27c. per hour in 1915, to 42c. in 1918; while the southern rate increased from 18c. to 34c.; the central group from 22c. to 37c.; and the eastern group from 23c. to 40c.

In spite of the general business uncertainty and resulting depression, wages paid to unskilled labor, by water works in the vicinity of Boston, have advanced from approximately 41c. per hour, under date of September 14th, 1918, to approximately 46c. per hour in April, 1919, without allowance for the effect of vacations and holidays under pay, granted by some works. Present (June, 1919) conditions give little if any indication of reduction in prices this year, or hope for any marked reduction in the future.

Cast-iron pipe prices (Table II.) which had about trebled at their maximum point, have now receded to about twice pre-war figures. *Valves, hydrants and pumps*, which had more than doubled in price, are now to be had at an advance of something over seven-eighths of pre-war prices. *Coal and fuel oil prices*, which more than doubled, have receded somewhat. *Chemicals* used in the purification of water, which, by reason of outstanding contracts showed an average advance of but one-third, though the market price had increased approximately three-fourths, have decreased so that the present excess cost is about one-half over pre-war prices.

Future prices—Engineers prefer the role of interpreter of facts to that of prophet. It is desirable, however, to note here probable future price tendencies. First, with respect to unskilled labor, no marked change is to be looked for; and with respect to the rates paid to water works employees, it is believed that the prices now paid are likely to continue in most cases, and to increase rather than to decrease in the remaining cases. Unless Bolshevism runs its course in this country, or industrial depression should follow the war—neither of which seems likely—an active demand for labor is to be looked for in the near future. It is to be remembered that, despite the war, the population of this country has been increasing at a rapid rate. Immigration has been at a standstill, and in the light of home demand for labor abroad, does not seem likely to be active for some time to come. Many employers, contractors and labor leaders believe that in the not distant future this country is sure to feel the competition for available labor and that this will stimulate yet higher wage scales.

Necessary Improvements Should Go Forward

Second, with respect to materials of construction, there is greater hope for relief. Nevertheless, no substantial reduction in the price of cast-iron pipe, valves and hydrants seems likely for the present year, and but a gradual reduction is to be looked for in the future. In spite of the increased facilities for production, the labor, transportation and money conditions involved seem likely to make themselves adversely felt for some time, and the losses resulting from the war seem likely to be permanent.

Third, the materials of operation—coal, fuel oil, and chemicals—do not appear likely to decline markedly in cost, and such tendency toward decrease as there may be will probably cause the making of short-time, rather than long-time, contracts for such supplies.

The Future—The conclusion to be drawn from the present physical and financial condition of water works in the United States seems clearly to be that *necessary improvements should go forward as rapidly as possible.* It is desirable to restore public confidence and further the government's wise wish to give employment to idle labor. More important yet, *improvements are seriously needed to restore our normal high standard of water service, to safeguard adequately the public health.*

While city officials and water works men are hesitating, the large manufacturing interests, dominated by shrewd, farsighted business men, are going ahead with their construction work, with their plant extensions and housing projects, confident that postponement will at best offset increased cost in small measure; will probably involve loss in service or profit far exceeding any saving in construction cost; and at worst will involve yet higher costs, coupled with increasing difficulties due to a vanishing labor surplus.

The public is far more vitally interested in thoroughly good and adequate present service than in any probable saving to be effected by delaying construction to a later date, in anticipation of further, more or less problematical, decline in costs.

CEMENTS PRODUCING QUICK-HARDENING CONCRETE*

By P. H. Bates

IN the course of the investigations which the Pittsburgh Branch of the Bureau of Standards has been conducting dealing with the various problems relating to Portland cement, there have been made a number of cements which are characterized by a very high early strength. This is developed when the cements are used either as mortars or concretes. These cements have been made in a manner differing in no wise from that used in the manufacture of Portland cement. However, the composition of the materials entering into their manufacture was decidedly different, limestone and calcined alumina having been used in some of the raw mixes, and in others the alumina was replaced in part by kaolin or bauxite in order to determine the effect of impurities on their general properties. While such materials have been the subject of research by others, especially Spackman, their property of developing very high early strengths is not generally known. It is believed that the data presented in this paper, especially that dealing with the concrete, are the first of their kind ever presented.

The data dealing with the aluminates are augmented by some obtained in making concrete from "Sorel cement" which, as is generally known, is light calcined magnesite guaged with magnesium chloride. It has been unofficially reported that during the recent war the enemy used a concrete made of such a cement for "setting up" their large guns. As it obtains the greater part of its strength within 24 hours, and as this strength equals that obtained by a Portland cement at the end of two or three weeks, the possibility of using it becomes very attractive. The data herewith presented were obtained in making a limited number of concretes, but it is believed that such data, in so far as they relate to concretes, have never before been presented.

Concrete Made with Sorel Cement

It is not intended to go into any great detail in presenting these data. For this reason, the nature and general properties of this cement will be touched upon but briefly. The fact that magnesium oxide, when mixed with a solution of magnesium chloride, will harden was possibly first known by Sorel in 1853. From him it has at least taken its more common name. The physical character of the oxide and the permissible impurities, the concentration of the chloride and its permissible impurities, and the nature of the hardened material have all been the subject of extended investigations. Briefly, the results show that the purer the ingredients, both oxide and chloride, the better the resulting cement. The oxide must be produced by burning a carbonate to such a temperature only that a plastic mass results when it is gauged with water. Too high a temperature of calcination produces a very inferior oxide. The nature of the hardening has never been satisfactorily solved. For a late investigation and discussion of these points and a satisfactory bibliography, reference should be made to Bulletin No. 879 of the University of Wisconsin.

At the present time this cement is used in rather large quantities for making a resilient flooring which is usually referred to as "composition flooring." When so used the aggregate is composed of asbestos fibre, sawdust, inert finely ground filler as sand and coloring matter. This flooring is widely used in a monolithic form in office buildings, passenger and subway cars and interior ship decks. Recently a mortar very similar in nature to the above, excepting the omission of the fibrous material, has been rather successfully used as a stucco.

The magnesia used in the present investigation was made from magnesite mined in California. It was a mixture of two shipments from two manufacturers of flooring. Both had given satisfactory results when used in flooring mixes. No data are at hand which would enable one familiar with portland cement to form an idea of the relative strengths which these would develop in the usual small briquette or compression specimen. The small specimens made were of a flooring composition and as such were composed of 50% magnesia, 12% asbestos, 10% sawdust, 22% ground sand and 6% iron oxide, all by weight. This mixture when gauged with 52% of a solution of chloride having a gravity of 1.1885 (about 23° Baumé) gave the following strengths in pounds per square inch:—

Specimen.	24 Hours.	7 Days.	28 Days.	90 Days.
A				
Tension	531	841	1087	1034
Compression .	2240	3795	5330	4340
B				
Tension	576	900	935	1049
Compression .	2900	4240	5300	5370

The tension specimens were of the form specified in the A.S.T.M. Standard Specifications and Tests for Portland Cement. The compression specimens were 2 by 4-in. cylinders. All specimens were stored in air until broken.

The analyses of the mixed oxides and the chloride were as follows:—

	Oxide.	Chloride.
Silica	5.14 per cent.	....
Alumina	0.78 "	....
Iron oxide	0.57 "	....
Lime	5.69 "	0.20 per cent.
Magnesia	85.01 "	9.24 "
Ignition loss	2.86 "	....
Potassium oxide	.... "	0.17 "
Sodium oxide	.... "	0.70 "
Chlorine	.... "	16.54 "

In Table 1 is shown the strength of the concrete made from this mixed oxide and also the compressive strength developed by a Portland-cement concrete using the same proportions of the same aggregates. Notwithstanding the fact that the specific gravity of the magnesia is very close to that of Portland cement (3.08 for the magnesia and 3.12 for the cement), the volume occupied by the same weight of the two differs very materially. As the magnesia weighed but 51 lb. per cu. ft., the actual percentage by weight of the magnesia in any one concrete was decidedly less than the percentage of Portland cement. For this rea-

TABLE 1—COMPARISON OF COMPRESSIVE STRENGTHS OF SOREL AND PORTLAND-CEMENT CONCRETES

6 BY 12-IN CYLINDERS. STRENGTHS IN POUNDS PER SQUARE INCH.

Proportions by Volume.	Percentage of Cement by Weight.		24 Hours.		48 Hours.		7 Days.		Per cent H_2O in Portland-Cement Concrete.	Per cent $MgCl_2$ in Sorel-Cement Concrete
	Portland.	MgO.	Portland.	MgO.	Portland.	MgO.	Portland.	MgO.		
GRAVEL AGGREGATE.										
1 : 0.5 : 1.5	33.3	20.3	.	1740	1570	3490	2965	2910	12.1	4.7
1 : 1.0 : 3.0	20.0	11.3	.	1705	1115	2260	2029	2850	7.8	9.5
1 : 2 : 4.5	14.3	8.5	.	1755	680	2145	1430	2740	7.9	9.8
*1 : 1.5 : 4.5		14.3	. .	2880		3315		2720		12.1
LIMESTONE AGGREGATE.										
1 : 1 : 1½	35.2	21.8	....	2985	2260	3990	3919	4320	12.2	18.5
1 : 1½ : 2½	21.4	12.2	....	1940	1340	2805	2990	2970	9.9	13.7
1 : 2 : 4	15.4	8.5	....	1925	655	2330	1755	2480	9.5	12.8
*1 : 2 : 4		15.4	....	3270	...	4020	.	4320		13.7
COARSE SAND AGGREGATE.										
1 : 0.5 : 1.5	34.0	20.8	.	2060	1715	2570	3270	2735	13.2	20.0
1 : 1.0 : 3.0	20.6	11.6		1910	545	2225	1635	2430	11.4	16.0
1 : 2 : 4.5	11.7	8.9		935	325	1695	985	1870	11.4	14.7
*1 : 1.5 : 4.5		14.7		2355		3260		3190		15.7

NOTE.—The percentage by weight of MgO in 1.0.5 1.5 and 1 : 1½ is but very little greater than the percentage by weight of Portland cement in 1: 1.0 3.0 and 1: 1½ : 2½, respectively.

* MgO proportioned by weight, making weight percentage of MgO equal weight percentage Portland cement in 1 : 1.5 : 4.5 and 1 : 2 : 4

*Paper read at the annual meeting of the American Society for Testing Materials, June 24th to 27th, 1919.

son the 1: 6 concrete was proportioned both by weight and by volume, when the magnesia was used as the cementing material. All specimens were stored in the air until broken. The gravel used was obtained from the Allegheny River and was screened between a ⅛-in. and 1½-in. screen. It contained an excessive amount of the finer sizes. The lime stone was a rather soft stone screened between the ¼-in. and 1-in. screens. The "coarse sand" aggregate was sand from the Allegheny River screened between the ⅛-in. and ¼-in. screens.

As the information sought had to do alone with early strengths, specimens were made for breaking at 24 hours,

TABLE 2—COMPOSITION, CONSTITUTION AND TEMPERATURES OF BURNING OF CALCIUM-ALUMINATE CEMENTS

ALL COMPOSITIONS IN PER CENT.

Cement No.	1	2	3	4	5	6	7	8
SiO_2	0 44	0 76	9 41	10 48	17 23	17 38	11 33	0 68
Al_2O_3	62 31	61 25	55 09	46 71	39 96	30 52	47 66	74 11
Fe_2O_3	0 51	0 60	2 04	2 13	2 57	1 85	3 10	0 40
CaO	36 69	36 32	30 73	39 79	38 84	46 72	34 87	23 82
MgO	0 36	0 48	2 95	1 04	1 29	2 27	3 66	0 81
Ignition loss	0 07	0 50	0 08	0 32	0 14	0 78	0 17	0 38
	100 38	99 91	100 30	100 47	100 03	100 52	100 19	100 20
Temperature of Burning, deg. Cent	1460	1480	1490	1380	1455	1360	1445	1500
Constituents[1]	C A 2CS	3C 5A CA 2CS	CA 3C 3A 2CS	CA 3C 5A 2CAS	2CAS CA 2CS	2CAS CA 2CS	2CS 5C 3A CA	2CAS CA 2CS	CA 3C 5A 2CAS

[1] C = CaO; A = Al_2O_3; S = SiO_2.

48 hours and 7 days in the case of those made with magnesia and 48 hours and 7 days when Portland cement was used.

The results show that the Sorel-cement concretes, with but two exceptions, have a strength at 48 hours greater than that obtained by the use of Portland cement in 7 days. However, it is also seen that there is in general but little increase in the strength of the former between the 48-hour period and the 7-day period. The results obtained at all periods from the Sorel-cement concrete proportioned by weight are generally higher than those obtained when the proportioning was done by volume, regardless of what the proportions were. This clearly shows that for such a light material the proportions should be decidedly different from

TABLE 3—TIME OF SETTING AND FINENESS OF CALCIUM-ALUMINATE CEMENTS

Cement No	Initial Set. Gillmore hr. min.	Initial Set. Vicat. hr. min.	Final Set. Gillmore. hr. min.	Final Set. Vicat. hr. min.	Per cent Passing 200-Mesh.
1	0 55	0 25	4 45	2 10	83 0
2	0 30	0 12	2 0	0 50	80 0
3	6 25	5 15		7 0	81 3
4	0 35	0 7	3 30	1 15	78 0
5	0 40	0 15	4 45	3 15	80 3
6	0 7	0 2	0 45	0 12	76 4
7	6 0	3 45	*	*	79 8
8	7 0	3 30	*	*	85 6

* Final Set between 8 and 16 hours.

those generally used with Portland cement. It would seem as if too much magnesia was used in the rich concretes and too little in the lean ones when the proportioning was carried out by volume.

Attention should be called to the difference in the manner in which the hardening of the two concretes takes place. In a Portland-cement concrete, the cement hardens by the action of the added water. During the process of hardening it is immersed in an atmosphere containing in a greater or less degree one of the essential elements of the process, that is, water, either as a liquid or vapor. On the other hand, in the Sorel-cement concrete the hardening takes place as a result of the action of the chloride on the oxide. The chloride is always essential, but any deficiency, as for instance the use of a too dilute solution, or any marked excess, is injurious. Therefore, not only the ratios between the aggregate and the magnesia must be studied, but also the ratio between the chloride and the magnesia.

While the results do show the lack of proper proportioning of both the magnesia and the chloride, yet these poorly proportioned concretes show in 24 hours as high strengths as the more properly proportioned Portland-cement concretes show in seven days. Another point should be remembered in regard to these Sorel-cement concretes, that is, they cannot be frozen. Temperatures below freezing will retard the hardening to a degree, but the freezing point of the solution is so low that no care need to taken to prevent damage from low temperatures.

Concrete Made with Calcium-Aluminate Cements

The calcium aluminates were all made in the experimental rotary kiln of the bureau. The composition of these, the constitution arranged in order of the amounts present, and the temperatures of burning are given in Table 2. The fineness and the time of setting* are given in Table 3.

With the exception of cement No. 6, no particular difficulty was encountered in burning. On account of the composition of this cement, its position in the ternary system CaO-Al_2O_3—SiO_2 was such that it was located in a field having both a low burning temperature and also one in which the orthosilicate predominate. This combination

TABLE 4—COMPRESSIVE STRENGTH OF 1: 3 STANDARD SAND MORTARS, FROM CALCIUM-ALUMINATE CEMENTS

ALL VALUES IN POUNDS PER SQUARE INCH.

Tested at	24 Hours.	7 Days.	28 Days.	28 Days.	90 Days.	26 Weeks.		1 Year.
Stored in	Water.			C. S.	Water.	Water.	C. S.	Water.
Cement No.								
1	3570	5945	3765	6815	3945	5330	6015	3045
2	4260	4760	3945	7625	4735	4570	5290	4430
3	2240	4940	6475	8000	7180	7760	11 050	5315
4	4410	4880	5285	6400	4565	3470	3480	3200
5	1035	1400	1820	2875	2070	2900	3845	2410
6	1340	1260	1425	3130	1680	1895	4345	2310
7	2163	5140	3930	7085	5205	3605	6090	5225
8	2860	8610	7845	10 690	8260	6380	8045	8945

C. S.—Stored for one quarter of period in water and the remainder in the air of the laboratory.

always produces a material which fluxes at such a temperature that the silicate on cooling reverts to the Υ form from the β form of the silicate. This reversion is manifested by the "dusting" of the clinker. It was possible to produce this particular cement only either in a decidedly underburned condition, or overburned to such a degree that it fell from the kiln in large, soft balls, which dusted on cooling unless quickly water quenched. The latter procedure of burning, without quenching, was used. Cement No. 4 was made from a very hard clinker but the latter did not show any tendency toward dusting. The clinker of the other cements was of the porous character of normal Portland clinker. Those low in iron oxide were white to yellowish in color; none of them had the glistening black appearance of Portland clinker, the darkest being a dark reddish brown. The raw materials used were calcined alumina and limestone for cements Nos. 1, 2 and 8; in Nos. 3, 4 and 5 the same materials were used but part of the alumina was replaced by a kaolin, thus reducing the alumina content of the mix but increasing the silica con-

*In carrying out the investigation presented here, no addition of SO_3 in any form was made to the cements. Work carried on at the same time as this presented here showed that such additions accelerated the time of set and caused a reduction in both the tensile and compressive strength.

tent. In No. 6 it was necessary to add some very finely ground flint, in order to secure the desired silica content, in addition to the kaolin, alumina and limestone, and iron oxide. In No. 7 bauxite, limestone and iron oxide were the raw materials.

Reference should be made to the work of Rankin, "The Ternary System CaO-Al_2O_3-SiO_2," and the author, "The Hydraulic Properties of the Calcium Aluminates," for further information in regard to the general properties of the constituents of these cements. For this present paper dealing more particularly with concrete made from them, it is not desirable to give more in regard to their properties than their reaction with water. Those aluminates indicated in Table 2, as being present in these cements, all react with water to form the hydrated form of $3CaO \cdot Al_2O_3$.* Such a reaction requires the formation of hydrated alumina. The amount of the latter will depend upon the amount of the alumina in the cement, consequently the $3CaO \cdot 5Al_2O_3$ will give the most and the $5CaO \cdot 3Al_2O_3$ the least. This hydrated alumina is, as is well known, a colloid and, when formed under the conditions indicated above, constitutes the greater part of the cementitious material of these compounds.

The higher the alumina content in any of the aluminates, the slower will be the reaction with water and consequently the slower will be the time of setting. This is shown in Table 3, but not very clearly unless studied in connection with the relative amounts of the constituents shown in Table 2. The former table shows that cement No. 3 has a slower setting time than cements Nos. 1 or 2, and also a lesser alumina content. The latter table, however, shows the presence of a large amount of silica and therefore the presence of a quantity of silicate which reduces the amount of alumina in the former cement and also retards the setting time. The two silicates present in these cements react very slowly with water, in fact the ternary compound $2\ CaO,Al_2O_3.SiO_2$ reacts so slowly that it will not form a cementing material, while the orthosilicate, $2\ CaO.SiO_2$, at the end of a year shows but little more than 5% water of hydration but a very satisfactory strength. Also a comparison of cement No. 8 with cements Nos. 1 and 2, or cement No. 7 with Nos. 5 and 6 will confirm the statement that increasing alumina content gives a slower setting cement. This has been more strikingly shown in other work carried on with the pure compounds when it was found that the tricalcium aluminate—the aluminate lowest in alumina—always gives a flash set.

With the exceptions of cements Nos. 2, 3 and 8, the burning temperatures used were either those generally used in burning Portland cement or a little lower. The temperatures used in these three exceptions were not much in excess of that infrequently used in making the latter cement and can be comparatively easily reached in a rotary kiln. One point in particular should be noted: it is impossible to produce an unsound cement unless a temperature far below that used in Portland cement practice were attempted. Slight underburning or burning at a temperature of 100° lower than that given would have produced an aluminate lower in alumina and free alumina.

Table 5 shows the strengths produced by the cements when tested in the form of a 6 by 12-in. cylinder as a 1: 1½: 4½ gravel concrete. In order that some idea may be obtained in a comparative way of their deportment as a mortar, the compressive strengths of some 1: 3 standard sand 2-in. cubes are given in Table 4. Previous work showed that, on account of the large amounts of colloidal material formed in the process of hardening, retrogression is likely to be shown by any specimens stored continuously in water or the damp closet. At certain periods, therefore, some of the specimens were removed from the water or damp closet and placed in the air of the laboratory until broken.

These two latter tables very clearly show the high 24-hour strengths. Special mention should surely be made of strengths of 2,800 to 3,100 lb. per sq. in. for a 1: 6 concrete at the end of 24 hours. The strengths of some of the 1: 3 mortars at the end of the same time is just as unusually high. The gain in strength with aging is also quite large, although maximum strength is reached at a comparatively early period. Consequently some very phenomenal strengths for either kind of a specimen are developed. A compressive strength of 8,610 lbs. per sq. in. at seven days for 1: 3 mortar or 6,010 lbs. at the same period for 1: 6 concrete are surely striking. While these results represent some of the maximum ones obtained, there are many other very exceptional high strengths shown in the tables, when these are compared with the results generally obtained with Portland cement.

TABLE 5—COMPRESSIVE STRENGTH OF 1: 6 AND 1: 12 GRAVEL CONCRETE, FROM CALCIUM-ALUMINATE CEMENTS

ALL VALUES IN POUNDS PER SQUARE INCH.

Tested	24 Hours.		7 Days.		28 Days.		90 Days.		26 Weeks.		1 Year			
Proportions[b]	1 : 6	1 : 12	1 : 6	1 : 12	1 : 6	1 : 12	1 : 6	1 : 12	1 : 6	1 : 12	1 : 6	1 : 6[a]	1 : 12	1 : 12[a]
Cement No.														
1	2825	....	3270	....	3310	.	4150	.	4160	.	3310	3590	.	.
2	3000	....	4150	....	4740	.	3480	....	1760	.	1760	2360	.	.
3	Soft	....	2175	....	3680	.	3990	....	4525	.	4135	5660	.	.
4	3145	880	3570	1005	3370	1000	2930	875	2565	800	2965	3280	980	1275
5	310	Soft	885	225	1250	365	1050	390	1270	550	1460	2110	570	870
6	840	275	765	275	990	305	1260	400	1515	470	1440	2035	470	910
7	1475	455	4135	1405	4625	1500	4640	1600	4450	1580	4650	5300	1350	1815
8	2930	890	6010	2270	7060	3415	7030	3980	7610	3910	6720	8220	3930	4445

[a] All specimens in these columns were stored for the first 4 months in the damp closet and for the remainder of the period in the air of the laboratory. All other specimens were stored in the damp closet for the entire period aged.
[b] Contained 3 per cent plaster

An examination of the tables shows that the maximum strength for the water or damp closet stored specimens was attained at some period previous to one year. As stated before, the quick hardening is due to a great amount of hydrated material rapidly formed. This is also in the colloidal form and will, therefore, in the presence of excess water, take up in a comparatively short time such an excess of the latter that there is a reduction in strength. It will not take up enough from air of the usual humidity to materially affect the strength. It does, however, lose water to the latter to a certain extent. It is this latter loss of water with consequent drying out of the colloid which causes the increase in strength of the water-air or damp closet-air storage over the storage in the water or damp closet alone.

It is interesting to note that in the case of the mortar specimens, cements Nos. 3, 5 and 6 developed the highest strengths by the combined method of storage at the end of the 26-week period, while the other cements developed their maximum strength by this method of storage at 28 days. Apparently, therefore, the latter were much quicker hardening than the former. Concrete specimens aged by the combined method were broken only at the one-year period. At this period, by this method of storage, maximum strength was developed by all the cements except Nos. 4 and 2. These latter developed maximum strength by damp closet storage at 7 and 28 days respectively. The continued storage of these two in the damp closet until removed to the air apparently caused such excessive hydration that subsequent drying out could not cause sufficient gain in strength to bring back the maximum strength shown at the earlier period. A shorter period of damp closet storage before the removal to the air would have been necessary in these two cases to have brought out higher

(Concluded on page 117)

*The amount of water of hydration has never been very closely determined. Some water is lost at such low temperatures, that adhering water or moisture cannot be removed without removing some combined water.

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EXCELLENT REPORT ON ONTARIO TRADE

IN his first annual report on the trade of the Province of Ontario, Fred. W. Field, His Majesty's Trade Commissioner at Toronto, has covered a vast range of subjects in a most succinct and business-like manner. His report is not at all perfunctory, but to the contrary, enters into the subject in a most enthusiastic manner, and portrays real interest in the work.

While compiled entirely for the information of the British manufacturer, and presented to the British Parliament last month by command of His Majesty, the report will prove very interesting to the business men of Ontario and Canada generally. It is prefaced with a brief report on the trade of Canada and Newfoundland, owing to the fact that G. T. Milne, His Majesty's Senior Trade Commissioner in Canada, was transferred from Australia only a few months ago and had not been in Canada sufficiently long to undertake a report on general conditions.

The report is published in a booklet of 96 pages, 6 ins. by 9½ ins. The Canadian report covers financial conditions, crops, railways, minerals and mining, fisheries, lumber, immigration, scientific research, credit conditions and commercial failures, war work, iron and steel, shipbuilding and shipping program, pulp and paper, motor cars and trucks, and import trade.

The Ontario report, which forms the major portion of the booklet, covers representation of British firms in Canada, selling goods on consignment, invoices, New York agencies, designs and patterns, advertising, catalogues, moving pictures, keeping in touch with one's countrymen, visits to Ontario, engineering practice, conventions, correspondence, general conditions, crops, farm live stock, wool, minerals, lumber, fisheries, commodity prices, rubber, financial conditions, railways, canals, Toronto harbor improvements, Hydro-Electric Power Commission, road building, public works, vocational training for returned soldiers, Ontario Bulk Sales Act, Ontario Temperance Act, new lines being manufactured in Ontario, new works, munition works, national manufacturing works, banking assistance, earnings of industries, Reconstruction Association, supply of raw materials, raw materials and finished products, export trade, United States factories in Ontario, United Kingdom factories in Ontario, maintenance of industrial activity, industrial and trade organizations, iron and steel shipbuilding, lumber, pulp and paper, textiles, wool, linen, chemicals, dyes, motor cars and trucks, rubber industry, dry goods, cotton goods, gloves, metals and machinery, tools and hardware, cutlery, paints and varnishes, electric lamps, illuminating glassware, chinaware and groceries.

Appended to Mr. Field's report are brief reports from the Imperial trade correspondents at Halifax, St. John, Quebec, Winnipeg, Calgary, Victoria, Vancouver and St. John's, Nfld.; also appendices covering statistics of the pulp and paper industry for the year 1917 for the Province of Ontario, and imports into Canada for the fiscal years ended March, 1914 and 1918, compared.

In his advice to United Kingdom manufacturers seeking trade in Ontario, Mr. Field urges a larger measure of support of the Canadian representatives of British firms. The United States firms, he says, generally appoint the right man as agent and allow him adequate expenses and considerable freedom of action, whereas often a British representative is hampered by an inadequate allowance and other restrictions.

During the periods of trade depression, says Mr. Field, it is not advisable nor desirable to sever connections with a good agent as some British firms did, for example, at the outbreak of war. "A satisfactory local agent is an excellent asset," he states, "and it is a far better policy to make some arrangement to retain his services even when a dull business period arrives. This is done by our principal competitors in this market. A Toronto agency, for instance, was paid a substantial monthly retainer by a German house in New York, one of their principals, despite the fact that business was not obtainable in Ontario in their line for a considerable period. The German house wrote the Toronto firm saying: 'Even if you cannot sell goods at present, your experience and knowledge of the market are of value to us. Send us a detailed monthly report of conditions and the outlook in our line.'"

Mr. Field also urges more extensive advertising in the trade and technical journals of Canada. "With the keen competition to be met in all lines," he says, "and in a market which buys largely the goods for which publicity has helped to create a demand, it is necessary to have a continually favorable atmosphere to assist the salesman. Spasmodic advertising is of little value. A well prepared and properly conducted campaign, occupying a long period, then to be renewed, gives the greatest service."

Mr. Field has been extremely active during the first year of his office as trade commissioner, and his report reflects the great benefit that will accrue to British manufacturers and Canadian importers as a result of his further efforts. Few men are better posted than is Mr. Field on general economic and trade conditions in Canada; moreover, while working in the interests of British trade, he does not ignore the rights of Canadian manufacturers, and rarely does he encourage the importation of goods that can be satisfactorily supplied by Canadian factories.

AUTO TRUCK PERIL FOR HYDRANTS

DURING the round table discussion at the Buffalo convention of the American Water Works Association, it became very evident that a new problem has appeared for the water works engineers and superintendents of Canada and the United States, namely, the destruction of post hydrants by the heavy auto trucks that are now in general use. New York's experience has shown that the strength of the hydrants cannot be increased sufficiently to withstand the impact of a heavy auto truck skidding against it or backing into it. High pressure hydrants having a thickness of metal

of 15 16-in. have been broken, as well as the ordinary type of hydrants.

William W. Brush, deputy chief engineer of the water works department of New York City, has advised the American Water Works' Association that there are several possible answers to the problem. First, there is the flush hydrant, but this type has not yet made appreciable progress. Secondly, in Boston a change has been made in the type of post hydrant which up to date has opened with the pressure. The compression type of hydrant opening against the pressure, is being substituted. A third possible solution is to move the hydrants from the curb line to the building line, but most water works superintendents will probably leave the hydrants in their present location and assume the additional cost of maintenance.

The cost of repairing the broken hydrants is materially reduced if the standpipes are repaired by welding, which can be done successfully with modern machinery, says Mr. Brush, at a cost of from $6 to $8 per standpipe.

CEMENTS PRODUCING QUICK-HARDENING CONCRETE

(Continued from page 115)

maximum strengths. It should be remembered that the high early strengths are due entirely to rapid and more thorough hydration in the short intervals.

After the high results of the 1: 6 concretes were obtained, it was thought desirable to make some leaner concretes. Consequently a 1: 3: 9 gravel concrete was made, using certain of the cements of which there was a sufficient amount available. Even such lean concretes developed surprising strengths in several cases. This is especially true of cement No. 8 which developed a strength of 3,415 lbs. per sq. in. at 28 days and 3,980 lbs. at 90 days, and a maximum strength, by the combined storage, of 4.445 lbs. per sq. in. at one year.

In conclusion it may be stated, therefore, that the aluminates of lime, even when they contain such amounts of impurities as 10% silicia and 3% iron oxide, constitute a material which is a very valuable cementing medium when gauged with water. This particular value lies in the high early strengths which they develop. The greater the amount of the alumina present, as an aluminate of lime, the greater will be the early strength. Under certain conditions of curing there is a marked increase of strength with age, but this does not extend over a very long period of time. It also appears that if the concrete is subjected to an excess of water during curing there will be a decrease in strength. Such amounts of moisture as are usually present in the air do not materially affect the strength. It appears, therefore, that these cements might be of considerable value for certain special uses, where the principal requisite would be quick hardening.

The United States Engineering Societies' Employment Bureau received 2,891 applications for employment from December 1st, 1918, to May 1st, 1919, and placed 423 of the applicants. The total expenses from January 1st to May 31st were $5,815. The manager of the bureau states that there is every reason to believe that many more have been placed who have failed to notify the bureau, so that the average cost of placing these men probably did not greatly exceed $10.

The Ohio Electric & Controller Co., of Cleveland, Ohio, have appointed the following representatives:—Kelly Powell, Ltd., 403 McArthur Bldg., Winnipeg; Wonham Bates & Goode, Inc., Dominion Express Bldg., Montreal. They have also appointed the following export agents:—Gustave Neilson, A. S., Christiana, for Norway, Sweden and Denmark; Mitsui & Co., 65 Broadway, New York, for Japan, China, Phillipine Islands and Hawaii; Wonham Bates & Co., Inc., 17 Battery Place, New York, for Great Britain, France, Cuba and South America.

PERSONALS

Lt.-Col. Harold L. Trotter, who is a partner in the Henry Holgate firm of consulting engineers, Montreal, recently returned to Canada in command of the 11th Battalion, Canadian Engineers. Col. H. L. Trotter is a son of Col. W. C. Trotter, who for many years has been president of the Standard Clay Products, Ltd., of St. John's, P.Q., and New Glasgow, N.S. Col. H. L. Trotter graduated in 1903 from the Royal Military College, Kingston, with high honors, and then joined the firm of Ross & Holgate, consulting engineers, Montreal. When Mr. Ross and Mr. Holgate dissolved partnership, Col. Trotter joined Mr. Holgate as a junior partner. When war was declared, he enlisted immediately in the Canadian Engineers and was employed on fortifications below Quebec, and later installed new machinery in the Quebec Arsenal. He was also engaged in the construction of the Artillery Testing Depot in Quebec. From there he proceeded to Ottawa and, with the rank of major, took charge of an engineering company, but in England he was transferred to the 4th Division and placed in command of the 11th Field Company, which **later became the 11th Battalion.** This battalion particularly distinguished itself at the Somme in September, 1916, and at Canal du Nord two years later. The battalion was engaged in many other operations, however, including Vimy Ridge, Desire Trench, Arleux and Fresnoy, Lens, Hill 70, Passchendaele, Arras, Queant Drocourt Line, Denain, Valenciennes and the advance towards Mons. Col. Trotter was twice mentioned in despatches and was awarded the D.S.O.

Dr. Fred A. Adams of the Department of Health, Toronto, has been appointed medical health officer for the Essex border cities by the Essex Border Utilities Commission.

Lieut. Raymond Stevenson, of Fredericton, N.B., who recently returned home after four years' service overseas, has received an appointment on the Welland Canal staff.

Joseph Race, formerly city chemist and bacteriologist of Ottawa, Ont., returned home this week after six months' service in Siberia with the Canadian expeditionary force. Capt. Race will sail next week for a two or three months' visit to his former home near Manchester, England.

OBITUARY

Frank N. McReynolds, of the firm of Fussell & McReynolds, sewer contractors, Toronto, was accidentally drowned last Friday night at Honey Harbor, Ont., where he had gone for the purpose of repairing his summer cottage. A plank, across which Mr. McReynolds was walking, broke and dropped him into seven feet of water, where he was found on Sunday morning. It is thought that one end of the plank struck him on the head, rendering him unconscious. Mr. McReynolds was born 36 years ago at Cleveland, Ohio, but had resided in Toronto for the past eight years.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand or proposed, contracts awarded, changes in staffs, etc.

BRIDGES, ROADS AND STREETS

Alnwick, Ont.—The contract for building the Hill Brook concrete arch culvert and roadway embankment in parish of Alnwick, Northumberland County, has been awarded to F. E. Berryman, Woodstock. Tender price about $6,800.

Annapolis Royal, N.S.—Tenders will be received until July 14th by board of highway commissioners, department of public works, Halifax, for concrete abutments and bridge sheets on ten existing piers.

Burlington, Ont.—The department of public works plans to construct new steel lift bridge across the channel at Burlington. Plans have not yet been prepared. It is thought probable that foundations may be put in this year and the superstructure completed early next spring.

Compton, Que.—Tenders for gravelling the Sherbrooke-Norton road in the limits of the village of Compton, from the south to the north limits of the macadam road of the township of Compton, will be received until July 5th, by J. A. Rivard, secretary-treasurer, Compton.

Crowland, Ont.—The Crowland township council has awarded contract for concrete pavement to be constructed from the M.C.R. to Ontario Rd. and then along the Ontario Rd. west to the canal, to Somerville and Dilworth, at $18,454. One other tender was received from Shaffey and Shaughnessy at $21,608.

Edmonton, Alta.—Repairs to Jasper Ave. estimated at $200,000 is proposed by the city council.

Edmonton, Alta.—It is proposed to repair road to Clover Bar and to construct several culverts.

Elora, Ont.—Tenders will be received until July 11th by S. Aitcheson, reeve of Pilkington township, Elora, for construction of 75-foot steel bridge, with concrete abutment, over Grand River.

Eriksdale, Man.—Contract for grading 24 miles of road has been awarded to Madden-Ledger Co., Eriksdale.

Fredericton, N.B.—New tenders have been called for the Harris bridge in Sunbury County and for the bridge at the mouth of Parks Brook, in Northumberland County.

Gladstone, Man.—Tenders will be received by P. St. C. McGregor, secretary-treasurer, Westbourne municipality, Gladstone, Man., until noon, July 10th, for the construction of two pile bridges over Whitemud River. Plans, specifications, tender forms and other information may be obtained from the secretary-treasurer's office, municipal hall, or from the highway commissioner, parliament buildings, Winnipeg.

Hading, Man.—M. Kelly, Winnipeg, has the contract for concrete culverts. Tender price, $9,555.25.

Kingston, Ont.—Arrangements are practically completed for a highway crossing the counties of Frontenac, Leeds, Lanark and Carleton.

Lachine, Que.—The town council will shortly present by-law for repairing portion of public highway.

Lunenburg, N.S.—Contract for pavement and sidewalk has been awarded by the town council to J. E. Lusby, Amherst, N.S.

Marmora, Ont.—The county council contemplates the expenditure of $30,000 on highways to the north in Tudor boundary to Maynooth. On the road from Belleville to Maynooth there has already been spent $10,175. Twelve bridges, at a cost of $21,000, are to be constructed.

Marquis, Sask.—Jedeberg and Gusa, Swift Current, have been given the contract for road work. Tender price, approximately $10,000.

Montreal, Que.—The Automobile Club of Canada has recently been taking up the matter of constructing a good road through to St. Anne de Bellevue, about 24 miles from the centre of the city. This road follows along the lake-shore.

Montreal, Que.—The city council is planning to construct 21,420 square yards of pavements on Cote des Neiges Rd. The total cost of paving with granite blocks will be $153,987. Grading will cost $7,568, concrete foundation $32,130, granite blocks $98,532, curbstones $1,061, gulleys and manholes $698. Inspection and engineering is estimated at about $13,998.

Montreal, Que.—The municipality of St. Victoire plans considerable macadamizing work this year.

Montreal, Que.—Paving of Redpath St., at a cost of $21,-700 is contemplated.

Newmarket, Ont.—Tenders will soon be called for bridge on Prospect Ave.

North Bay, Ont.—Tenders will be received until noon, July 18th, by H. J. McAuslan, for curbs and gutters, sidewalks and pavements. Official advertisement in this issue.

Oakville, Ont.—Tenders will be received until July 7th, by the town clerk for material and construction of tarvia or asphalt-macadam pavements on six streets; also a concrete pavement and curb on Dunn St. N. Engineers, Jas. A. Bell and Son, St. Thomas, Ont.

Ottawa, Ont.—Tenders will be received until noon July 18th, by Lynwode Pereira, secretary, department of the interior, Ottawa, for construction of Castle-Laggan highway, second section from station 355+00 to station 960+00, Rocky Mountains Park, Alberta. Contractors may tender for the complete work, or separately, for two timber bridges, one over Corral Creek at station 785+00, and one over Pipestone Creek at station 732+00. Also for Mount Revelstoke highway, from station 643+00 to station 747+00, Mount Revelstoke Park, Field, B.C. Plans and copies of contract may be examined and specifications may be had from the commissioner of Dominion parks, Ottawa, Ont., the superintendents of the Dominion parks at Banff, Alta., Jasper, Alta., or Field, B.C., the Dominion lands offices at Moose Jaw, Edmonton, Calgary, Revelstoke, Kamloops and New Westminster, and the office of the inspector of Dominion lands agencies, Winnipeg, Man.

Ottawa, Ont.—The proposed new Cummings bridge will cost about $200,000.

Ottawa, Ont.—The county council has sanctioned the taking over of the Metcalfe Rd., Montreal Rd., Ottawa-Pembroke Rd. and the Ottawa-Kingston Rd. No estimate as to the proposed cost has been made.

Ottawa, Ont.—Work on the 84 miles of road, from Hull to Maniwaki Rd., will be started this summer.

Overbrook, Ont.—Tenders will be received until noon, July 7th, by Patterson and Byrne, 71½ Sparks St., Ottawa, for the construction of approximately 7,425 lineal feet of granolithic sidewalk, four feet in width, on Prince Albert and Queen Mary Sts., from the Russell Rd. to Victor St.

Owen Sound, Ont.—Tenders will be received until July 18th, for construction of asphalt concrete pavements. Official advertisement in this issue.

Pembroke, Ont.—The Renfrew county council at its recent session gave assent to a by-law for the raising of $150,-000 for the county good roads system. The money will be secured by the issue of debentures over a period of twenty years. With the provincial grants which will go with the expenditure of this money, the total will aggregate about $225,000.

Portage la Prairie, Man.—Thos. Bell, 600 Sherburn St., Winnipeg, has been given the contract for superstructures of three Howe truss bridges. Tender prices: Poplar Point, $7,800; High Bluff, $7,800; Edwin, $8,000.

Port Hope, Ont.—In addition to widening, grading and draining the Kingston Rd., between Port Hope and Grafton, the department of highways will erect steel and concrete bridges. Tenders have been awarded for 24-foot steel and concrete bridges over the Gage's Creek and at Pontiac stock farm on Front Rd. E., and tenders have been called for a similar bridge at Abbot's Creek, just outside the town of Cobourg.

Ridgeway, Ont.—The construction of a half mile of concrete roadway is proposed. George Ross, engineer, has estimated the cost at $3.11 per yard. Of the total work the county would contribute $14,600, the township $1,550, and the frontage $5,854. A. Nelson, chairman of the good roads committee, has asked the council to call for tenders on tar macadam as well as concrete.

Rockwood, Wellington County, Ont.—Tenders will be received by A. Wood, reeve of Eramosa township, Rockwood, until July 10th, for 45-foot concrete arch truss bridge at Shiloh. Engineers, Bowman and Connor, 61 Queen St. W., Toronto.

Sandwich, Ont.—By-law has been passed by the town council for paving Centre Rd.

Sarnia, Ont.—Contract for pavements has been awarded to the Warren Bituminous Paving Co., Sarnia.

Smithville, Ont.—Work is going forward on an eleven-mile tar macadam road, which is being built from this point to Beamsville, to connect with the Hamilton-Niagara provincial highway. Four miles are being laid on the Niagara-Homer stone road to Virgil, and one mile is in the process of completion near the town of Niagara-on-the-Lake. From the provincial highway at St. Davids, a road will be constructed to the county boundary. As soon as the road from the experimental station, at Vineland, to the provincial highway, is approved by the department, a distance of two-and-a-half miles, work will be begun on that portion. The road from the highway to Grimsby Park, of tar macadam, has just been completed.

St. Catharines, Ont.—The county of Lincoln intends expending $311,000 for construction and maintenance of its county roads this year. For this purpose two stone-crushing quarries are being operated, one at Jordon and the other at Smithville, each capable of turning out about one hundred yards of crushed stone per day. Both plants are equipped with steam drills, derrick and hoist, and will be in operation all summer.

Ste. Marthe, Que.—George Sequin has been awarded the contract for iron bridge over the Laraquette River.

Sydney, N.S.—City engineer McKinnon has reported the estimated expenditure on streets to be $14,800.

Three Rivers, Que.—Tenders will be received until noon, July 15th, by R. C. Desrochers, secretary, department of public works, Ottawa, for the construction of concrete sidewalks, grading and seeding, public building, Three Rivers, P.Q. Plans and specification can be seen and forms of tender obtained at the offices of the chief architect, department of public works, Ottawa; the overseer of Dominion buildings, central post-office, Montreal, and the district engineer, Three Rivers, Que.

Timiskaming, Que.—The Hamilton Bridge Co. have been awarded contract for bridge over Quinze River.

Toronto, Ont.—Contracts for pavements have been awarded by city council as follows: Asphalt pavements to the city at an aggregate price of $16,692; bitulithic pavements to the Warren Bituminous Co., at $4,506.95, for Orchard Park Rd. and $13,447.70 for Prescott Ave.; brick block pavement, to the Godson Contracting Co., for $4,149; track allowance on Front St., to the city, at $13,561.

Toronto, Ont.—Contracts for concrete sidewalks have been awarded by the township of York as follows: The Grant Contracting Co., Dennis, Priscilla and Trijama Avenues, and John Walker, Westwood and Hillbrow Avenues. Contracts for other four streets were not let. New tenders are being called for this work.

Toronto, Ont.—Gerrard St. E. is to be graded at an estimated cost of $53,650. The board of control has approved of the recommendation of the commissioner of works that the work should be done by day labor.

Trenton, Ont.—J. P. Gordon, engineer, is preparing plans and specifications for construction of sidewalks. Estimated cost, $30,000.

Vankleek Hill, Ont.—Contract for bituminous macadam road, and for concrete gutter and culvert has been awarded to Sutherland and Grant, 339 Chapel St., Ottawa. Approximate tender price, $28,000.

Victoriaville, Que.—Construction of pavements is contemplated at a cost of about $20,000.

Victoria, B.C.—The tender of Luney Bros. to supply about 4,000 cubic yards of filling for the Rock Bay bridge site has been accepted by the city council.

Wawanesa, Man.—Tenders will be received by Thos. Stevenson, secretary-treasurer of Oakland municipality, Wawanesa, Man., until 6 p.m., July 11th, for the construction of reinforced concrete culverts and bridge in the municipality of Oakland. Plans, specifications, tender forms and other information may be obtained at the office of the highway commissioner, parliament buildings, Winnipeg, or the office of the district engineer, Virden, or from the secretary-treasurer of the municipality. A marked cheque to the amount of five per cent. of the tender price must accompany each tender. The lowest or any tender not necessarily accepted.

Windsor, Ont.—An international memorial subway under the Detroit River, connecting Windsor and Detroit, is a possibility of the future. The department of works, Ottawa, is sending engineers to look over the proposition.

Yamaska, Que.—Tenders will soon be called by the department of public works, Quebec, for gravelling and repairing 75 miles of road between Yamaska and Sorel. M. Henry, engineer, department of roads, Quebec.

York Township, Ont.—The township council has decided to pave Glenholme Ave. at a cost of $19,200, Lander Ave. at $6,980, Northcliffe Boulevard at $8,058.60, Oakwood Ave. at $21,900.

WATER, SEWAGE AND REFUSE

Barrie, Ont.—Debentures will be issued to the amount of $25,000 by the municipal council of the township of Innisfal for construction of tile, stone or timber drains. R. M. McConkey, clerk.

Blenheim, Ont.—The township council contemplates constructing a drain.

Brandon, Man.—Extension of the water and sewer mains to Richmond Ave. on Eighteenth St., will be undertaken by the city council. A sufficient quantity of cast-iron water pipe and filling will be purchased from the Gartshore, Thomson Co., at $84.10 a ton. This pipe will come in carload lots, twenty tons of the six-inch pipe to a carload. A sufficient quantity of sewer pipe will also be purchased from the Alberta Clay Products Co., as per their tender of June 14th. The ten-inch pipe will cost 38½ cents, the single junction costing $1.74 each, while the twelve-inch will cost 49½ cents, with the single junction $2.23½.

Chatham, Ont.—The water board will engage an engineer to report on best methods to adopt in erection of a modern water works plant.

Dundas, Ont.—An analysis of the bids received by the town council shows that sewers will cost approximately $240,000. Taking the lowest tenders, the following will be the approximate cost of the work: Laying sewers, $110,000; disposal works, pump and outfall sewer, $50,000; sewer pipe, $35,000; sewage pumping machinery, $2,700; sprinkler equipment, cast-iron pipes, valves, penstocks, etc., $9,500. Total, $207,200. In addition to this there will be a cost for land, engineering and inspection of around $15,000, and for 300 house connections, estimated at $17,000, bringing the

total estimated cost up to $239,200. Engineer Murdock estimated the cost to be $250,000. When the plans were made Murray and Lowes estimated the cost of the sewers and the storm sewers at $175,000. The work tendered on includes the construction of the whole sewerage system as laid out by Murray and Lowes. It provides for sewers on South St., Ancaster Rd., Dundas St., Baldwin St., North St., York St., from Main to Hunter's farm, through Hunter's farm to disposal works, Hatt St., Market St., McNab St., Peel St., James St., King St., from York to Head, Cross St., from King to the Park, Park St., from York to Head St., Melville St., from Cross to Brock, Witherspoon St., from Market to end, Foundry St., Miller's Lane, Princess St., Albert St., Elgin St., Sydenham St., from Park to Short St., Victoria St., Alma St., from Cross to Sydenham. The bulk bids submitted were: F. F. Fry, $99,071; A. R. C. Smith, $102,172.75; Curran and Clement ,$152,031.65; Canadian Engineering and Construction Co., $216,583.65; Connolly-Agnew Construction Co., $228,222; B. O. Johnson, $166,667.75; Jas. D. Armstrong, $189,965. Contract has not yet been awarded.

Edmonton, Ont.—The following tenders were received by the city council for construction of clear water basin for the city filter plant: J. Dunlap, $20,123.89; Swanson and Kaline, $18,129.05; Hulbert, Wilson and Southworth, $19,348.10; Emil Skarin, $18,670. The contract has been awarded to Swanson and Kaline.

Edmonton, Alta.—Plumbing contract for agricultural schools at Raymond, Youngstown and Gleichen has been given to Ross Bros., Edmonton. Aggregate tender price, $33,000.

Hamilton, Ont.—The department of public works, Toronto, will soon call for tenders for reservoir.

Harriston, Ont.—Tenders will be received until July 14th, by W. D. McLellan, township clerk, for open ditch drain in the township of Minto. Total length of drain is 7,932 feet and amount of excavation is about 5,500 cubic yards.

Montreal, Que.—Contracts for sewers have been awarded to lowest bidders by the city council as follows: Alexandra Ave., to the De Keyser Wauters Co., at $17,931; Girouard Ave., to the De Keyser Wauters Co., at $4,809; Van Horne Ave., to the De Keyser Wauters Co., at $3,489; and Oxford Ave., to the Federal Engineering and Contracting Co., Ltd., at $10,785.

Montreal, Que.—The harbor commissioners have awarded the contract for erection of the piles for the new cold storage plant to the Douglas Milligan Co., Montreal, representatives of the McArthur Concrete Pile and Foundation Co., of New York. The work of placing test piles is almost finished, under the direction of F. W. Cowie, harbor engineer, and the permanent work will be proceeded with at once. Within the next few weeks contracts for the superstructure will be considered.

Newmarket, Ont.—Plans and specifications have been prepared and tenders will soon be called for construction of sewers on several streets.

Ottawa, Ont.—The city council will soon be asked to provide $100,000 to replace the intake pipe which now supplies water to the Queen St. pumping station.

Owen Sound, Ont.—One tender for construction of filter bed was received by the town council and that was considered too high, $3,000. Plans were prepared by engineer R. McDowall and work will be done under his direction.

Sandwich, Ont.—By-laws have been passed by the town council for constructing a sewer on Tonier St., also one on Brock St., and for water main on Wyandotte St.

Sarnia, Ont.—Tenders will be received by John A. Baird, city engineer, Sarnia, until noon, July 4th, for the construction of vitrified sewer on Mackenzie St. Plans, profiles, specifications and forms of tender may be seen at the office of the city engineer, City Hall.

Sarnia, Ont.—The city council has decided to construct a vitrified tile drain on Water St., at a cost of $1,220.45; also a vitrified tile sewer on Rose St., at a cost of $839.52. J. J. Stewart, city clerk.

Simcoe, Ont.—The public utilities commission is in the market for centrifugal pump for sewage disposal plant. Guy R. Marston, engineer.

St. John, N.B.—An engineer has advised that the new 36-inch pipe for the proposed extension of water main to Spruce Lake, would increase the supply of water from 4,000,000 gallons to 12,000,000 gallons a day. The cost of the proposed extension is $300,000. This would bring the total cost of the West Side water system to $700,000.

St. John, N.B.—Tenders will be received by J. B. Jones, commissioner W. and S. department, until July 17th for excavating and backfilling the trench for laying approximately 420 feet of 16-inch and 1,126 feet of 12-inch cast-iron pipe, according to the plans and specifications to be seen in the office of the city engineer.

Toronto, Ont.—Works commissioner R. C. Harris will present a report to the city council in the near future in which he will advocate the construction of a new filtration and pumping plant in the east end of the city (at Victoria Park), and the construction of new mains. Mr. Harris desires the plant to be designed for a capacity of 60-million imperial gallons a day. The construction of this plant will also mean the construction of a new intake at Victoria Park. It will relieve the filtration plants at the Island and will provide for the expected growth of population during the next few years.

Toronto, Ont.—Officials of the works department, city of Toronto, will visit Milwaukee at an early date, to investigate the activated sludge process. If they are satisfied with the progress that has been made by Milwaukee, the Toronto city council will allow the expenditure of $50,000 for an experimental unit which, if successful, will result in the construction of a large plant to handle all of Toronto's sewage.

Toronto, Ont.—Contract has been awarded by the city of Toronto for supply of filter alum for the current year to the Nichols Chemical Co., Toronto.

Verdun, Que.—$246,775 will be expended by the town council on improvements to water plant.

Verdun, Que.—Chas. Brandeis, engineer, has prepared plans and specifications for filtration system, water distribution, electric light and power system and an incineration system. The engineer has recommended the following: (a) Two 5,000,000-gallon electric pumps, a 4,000,000-gallon filtration plant and about 4,000 feet of 24-inch water main in the street, at an approximate cost of $246,775; (b) a 1,000 k.w. steam turbine generator and boilers, at an approximate cost of $150,000; and (c) an incineration plant for the destruction of garbage, which plant might also be used for the production of power, with the necessary dyke, etc., at an approximate cost of $106,150. Each of these amounts will be provided for by a separate loan by-law. T. F. Dwyer is the contractor for dyke.

Woodslie, Ont.—Tenders will be received by A. Mousseau, clerk of Maidstone, Woodslee, Ont., until noon, July 7th, for the dredging and other improvements of the Pipe Creek drain. Plans and specifications can be seen at the office of Jas. S. Laird, Essex, or at the office of the clerk at Woodslee.

Yellow Grass, Sask.—Contract for supply of water mains, valve, casing and cup, with plugs, ties and hydrant, has been awarded to H. C. Dupont, Yellow Grass, Sask.

BRIDGE TENDER

Tenders will be received up to noon, Friday, July 11th, for the erection of a thirty-foot concrete bridge on Prospect Street, Newmarket, Ontario. Plans and specifications may be seen at the office of the engineers, James, Loudon & Hertzberg, 36 Toronto Street.

Tenders must be marked, sealed and addressed to J. P. Anderson, Clerk, Newmarket, Ontario.

C. W. LUNDY, Chairman, Committee. P. J. ANDERSON, Clerk.

No Damage at these Curves!

Entrance to Queen Victoria Park, Niagara Falls, Ont. Roadway surface treated in June 1918 with "Tarvia-B."

When swift and heavy automobiles sweep around the bend of an ordinary macadam road the tires slip sidewise—not enough to skid, to be sure, but enough to rub and rasp the brittle macadam until the stones loosen and the surface ravels.

No road is better than its curves.

The curves are always the first spots in a road that need repair.

With plain macadam construction the curves are a *constant source of trouble and expense.*

Not so with Tarvia-macadam: Note the excellent condition of the curves in the Tarvia roads pictured here.

Curves have no terrors for Tarvia, because when it is used as a binder it forms a tough matrix for the crushed stone. Not only has Tarvia greater bonding power than natural binder, but it has the further element of *plasticity*, so that it yields instead of crumbling.

Tarvia solves motor-traffic problems.

The use of Tarvia reenforces the road-surface and makes it strong enough to resist motor-driven traffic, which to-day is the biggest problem of the roadmaker.

Likewise with the erosion problem: Water on steep grades washes out plain macadam but does not harm the Tarvia-macadam because it is absolutely waterproof.

And remember, Tarvia roads are also *frost-proof, mudless, and dustless,* and cost less than any other type of good-road construction.

Illustrated booklet describing the various Tarvia treatments free on request.

The Barrett Company LIMITED

MONTREAL TORONTO WINNIPEG VANCOUVER
ST. JOHN, N.B. HALIFAX, N.S. SYDNEY, N.S.

Summit Crescent, West Crescent Height, Westmount, a suburb of Montreal. Treated with Tarvia.

Special Service Department

This company has a corps of trained engineers and chemists who have given years of study to modern road problems. The advice of these men may be had for the asking by any one interested. If you will write to the nearest office regarding road problems and conditions in your vicinity, the matter will have prompt attention.

Main Driveway, Queen Victoria Park, Niagara Falls, Ont., north of the Administration Building.

York Township, Ont.—The township council has authorized the issue of $18,000 in debentures to cover cost of installing sanitary plumbing and drainage in King George and George Syme schools, S.S. No. 29. By-laws have been passed to lay approximately 30,000 feet of water mains through the north-eastern section of the township.

York Township, Ont.—The York township council proposes to install private sewerage and water works systems on the east side of the township. On the west side systems are now under construction. The district it is now proposed to improve lies south from St. Clair Ave. to the city limits and east from the Don to Scarborough townline. It is proposed to drain the district towards the Don, where a sewerage disposal plant will be erected. The water supply will be obtained from Lake Ontario.

LIGHT, HEAT AND POWER

Alexandria, Ont.—It is proposed to serve the village of Lancaster and the town of Alexandria with hydro-power from the St. Lawrence system. Investigations are being made to determine the most feasible way of meeting the needs of the district surrounding the municipalities.

Edmonton, Alta.—H. H. Depew, Edmonton, has the contract for electrical work for three agricultural colleges at Raymond, Youngstown and Gleichen. Aggregate tender price, $3,419.

Hamilton, Ont.—The Dominion Foundry Co. will install electric ovens at their plant.

Kapuskasing, Ont.—The Spruce Falls Pulp & Paper Co. expect to go ahead with the construction of a pulp mill near Spruce Falls, on the Kapuskasing River. In connection with this enterprise there will be a hydro-electric power development, with an initial output of 9,000 h.p., and an eight or nine-mile transmission line to the mill. American interests are said to be behind the company, and it is stated that the company has $6,000,000 capital underwritten by an American firm. E. Stewart, managing-director of the Canada Timber and Lands, Ltd., Standard Reliance Building, King St., Toronto, is promoting the company. Engineers are now at work on the property.

Kippawa, Que.—Contract has been let by the Kippawa Co., Ltd., for piping, to the John W. Danforth Co., of Buffalo, N.Y.

Kippawa, P.Q.—Contract was let recently by the Kippawa Co., Ltd., for valves to H. G. Hunter, Montreal, representing the Rensselaer Valve Co., of Troy, N.Y.

Mansfield, Ont.—The Galetta Electric Power and Milling Co. has decided to construct line from their plant to Mansfield.

Merrickville, Ont.—The new unit of the Rideau Power Co., of Merrickville, was put in operation on May 3rd, and the load on the system has been increased so that two additional blocks of power are required immediately.

Montreal, Que.—The Canada Electric Co., 250 Beaver Hall Hill, has been awarded the electrical contract for the extension of the academy of Notre Dame de Bonsecours on Fairmount Ave. Also for the Rushbrooke Protestant school, Verdun.

Montreal, Que.—L. E. Moulton & Co., 142 Inspector St., has been awarded the plumbing and heating contract for the new Davidson plant, Delisle St.

Nicomen Island, B.C.—No contract has been awarded by department of public works for dam, embankment and three groynes at Nicomen Island, Fraser River, B.C. It has been decided to call for new tenders some time next fall.

Parry Sound, Ont.—Contract has been awarded to W. M. Fletcher & Co., 151 Bloor St. W., Toronto, for the dam, power house and earth fill required in connection with the municipal hydro-electric power scheme that is being undertaken here. Contract price, $64,700. Contract for the electrical equipment, including generators, has been awarded to the Canadian Westinghouse Co., Ltd., Hamilton. Contract price, $21,060. C. H. and P. H. Mitchell, consulting engineers, Toronto.

Perth, Ont.—The hydro line, from Perth to High Falls, has been completed. A temporary transformer station has been installed at High Falls to supply power for construction purposes.

Portage la Prairie, Man.—This city will soon be supplied with hydro-electric power. Mayor Metcalfe.

Wellington, P.E.I.—A modern 4,000-volt distribution system is being constructed by the local commission to replace the 250-volt d.c. system, formerly owned by the W. P. Niles Seed Co.

RAILWAYS

New Waterford, N.S.—A proposal to extend the railway tracks from New Glasgow to this town is under consideration. A. Stuart Pratt, president, C. B. Electric Co.

Toronto, Ont.—It has been decided to straighten the north street railway curve on Broadview Ave. Estimated cost, $8,231.

FACTORIES AND LARGE BUILDINGS

Brandon, Man.—The city council proposes to erect an aerodrome in this city.

Chatham, Ont.—The Bell Telephone Co., Montreal, contemplates erection of telephone building.

Clarke City, Que.—The Gulf Pulp and Paper Co., Ltd., will soon erect addition to plant.

Donnacona, Que.—Time for receiving tenders for store and office building by Delisle and Floyd has been extended to July 2nd.

Edmonton, Alta.—Contract for three agricultural schools at Raymond, Youngstown and Gleichen has been awarded to Smith Bros. and Wilson, Lethbridge, for the aggregate sum of $144,000.

Falls View, Ont.—Tenders are being called by C. M. Borter for addition to public school, costing about $20,000.

Fredericton, N.B.—R. Chestnut & Sons contemplate erection of brick or concrete three-story building at an expenditure of about $25,000.

Fredericton, N.B.—The directors of the agricultural society have decided to erect a new exhibition building.

Fredericton, N.B.—The R. Chestnut and Sons, Co., Ltd., proposes to reconstruct three-story brick building into warehouse.

Fredericton, N.B.—Construction of a new union station near Regent St. is contemplated.

Galt, Ont.—Schultz Bros., Brantford, have been awarded the contract for Hugh McCulloch Memorial Nurses' Home.

Galt, Ont.—Tenders will be received by Joseph McCartney, secretary, housing commission, until July 15th, for all trades required in the erection of fifty houses, half to be of four rooms and half of six rooms, and alternately, for one hundred houses, half to be of four rooms and half of six rooms. Plans and specifications may be obtained from Evans and Hall, associated architects, 30 Water St. N., Galt, Ont.

Hamilton, Ont.—Contract for erecting bathing pavilion at Wabasso Park has been awarded to the Canadian Engineering and Contracting Co.. Tender price, $20,700. The T. J. Drake Co. submitted two tenders, one for $15,588, and another for $19,680. Other firms that tendered were: W. H. Yates, jun., $21,037; Frid Construction Co., $25,000; Wm. R. Tope, $24,290; Mitchell and Riddell, $21,300; and Stuart Bros., $26,820.

Hamilton, Ont.—New masonic temple to be erected here will cost $350,000.

Hamilton, Ont.—The Frid Construction Co. have been awarded the contract for erecting a boiler house at Gage Park. Estimated cost, $8,600.

BURLINGTON
STEEL CO LTD
HAMILTON
BARS BENT TO SHAPE
FOR BEAMS, STIRRUPS
ETC
STEEL BARS
FOR CONCRETE REINFORCEMENT
ROUNDS, SQUARES, TWISTED SQUARES,
FLATS, ANGLES.

Ingersoll, Ont.—Architect Murray, of London, has prepared plans for new sixteen-room school.

Kapuskasing, Ont.—New pulp mill and townsite are planned in connection with Spruce Falls Pulp & Paper Co. For further information, see item under "Kapuskasing" in Light, Heat and Power section of this issue.

Kingston, Ont.—It is proposed to erect new barracks at Barriefield.

Kitchener, Ont.—A new packing plant and abattoir will be erected on Guelph St., by Dumart Bros. Estimated cost, $75,000.

Leamington, Ont.—The Imperial Tobacco Co., 900 St. Antoine St., has awarded contract for plant to Archibald and Holmes, Toronto. Contract price, $125,000.

London, Ont.—Building permits since June 1st, number 95, the total value being $99,950.

Lotbiniere, Que.—The Lotbiniere Exposition Co. contemplates the erection of fair buildings. Estimated cost, $100,000.

Maisonneuve, Que.—The Anglin Norcross Co., 65 Victoria St., Montreal, has been awarded the contract for $20,000 warehouse for the United Shoe Machinery Co.

Montreal, Que.—The Laval Industrial Co. contemplates the erection of stamping works to cost $25,000.

Montreal, Que.—The Dominion Oilcloth Co., 1192 St. Catherine St. E., has awarded the contract for a $30,000 warehouse to J. Meloche, 1911 Masson St.

Montreal, Que.—Contract for construction of public baths has been awarded to Duraneau and Co., 113 Hamilton St., Emard Ward.

Montreal, Que.—Fire has destroyed one of the buildings in the C.P.R. Hochelaga yards. Loss estimated at $25,000.

Montreal, Que.—C. P. Fabien, 31 St. Cunegonde St., contemplates extension to refrigerator plant, at an approximate cost of $30,000.

New Toronto, Ont.—Contracts for the construction of 54 houses have been awarded by the local housing commission to Herbert Baxter. J. Doughty, Mimico, will install heating, plumbing and wiring.

Oshawa, Ont.—St. George's Church congregation contemplates erection of a $95,000 church.

Petrolia, Ont.—The Lambton County Corn Growers' Association contemplates the erection of a one-story steel fair building. Director, J. C. McMillan.

Picton, Ont.—The True Blue Orphanage will shortly enlarge their building. Estimated cost, $200,000.

Regina, Sask.—Alex. Pantages contemplates erection of new theatre with seating capacity of about 1,400.

Regina, Sask.—A new warehouse will be erected next year by the Saskatchewan General Trust Co.

Regina, Sask.—Tenders will soon be called for provincial police headquarters. Estimated cost, about $175,000.

Regina, Sask.—The Saskatchewan General Trust will erect a large store on the corner of Lorne St. and 11th Ave. Estimated cost, $30,000.

Sandwich, Ont.—A by-law will be voted on shortly to authorize expenditure of $50,000 for new school. Roger S. Agnelly, chairman.

Shawinigan Falls, Que.—A branch building costing $20,000 will be erected by the Royal Bank of Canada, Montreal.

St. John, N.B.—Tenders will be received until noon, July 4th, by R. C. Desrochers, secretary, department of public works, Ottawa, for alterations and additions to fittings in the post office. Plans and specification can be seen and forms of tender obtained at the offices of the chief architect, department of public works, Ottawa, and the superintendent of Dominion buildings, St. John, N.B.

St. Omer, Que.—The parish of St. Omer will remodel church at a cost of $22,000.

St. Thomas, Ont.—Contract for pavilion at Pinafore Park has been awarded to the Green Lumber Co. Tender price, $8,396. Other tenders were: Alfred Morris, $9,875; Sanders and Bell, $7,525, for carpenter work only; Orlando Beal, $1,639, for cement work.

Sydney, N.S.—Contract for new Roman Catholic church has been given to Bate, McMahon Co., Sydney. Tender price, $100,000.

Three Rivers, Que.—Thomas Trow, Port Henry, N.Y., contemplates erection of theatre to cost about $50,000.

Toronto, Ont.—Plans are being prepared for erection of modern reception hospital. Estimated cost, $50,000.

Toronto, Ont.—Tenders will be received by Wm. Steele and Sons Co., Ltd., until July 14th, for erection of furniture store building for the Adams Furniture Co., Ltd. Plans and specifications may be seen at the office of Wm. Steele and Sons Co., Ltd., 512 Ryrie Building, Toronto.

Walkerville, Ont.—The American Auto Trimming Co. will erect a five-story addition to their plant.

Walkerville, Ont.—The Peabody Manufacturing Co., Ltd., will erect a $500,000 textile plant here.

Windsor, Ont.—S. E. Dinsmore, Windsor, has been given the contract for addition to school. Tender price, $47,000.

MISCELLANEOUS

Brantford, Ont.—The war memorial committee has decided to erect an obelisk as a memorial to fallen heroes.

Connaught Station, Ont.—Tenders will be received until noon, July 15th, by R. C. Desrochers, secretary, department of public works, Ottawa, for the construction of a timber pilework wharf at Connaught Station, district of Timiskaming, Ont. Plans and forms of contract can be seen and specifications and forms of tender obtained at the department of public works, at the post office, Haileybury, Ont., and at the post office, Connaught Station, Ont.

Devil's Island, N.S.—The department of public works has awarded contract for repairs to breakwater to M. A. Condon and M. C. Denton, Digby, N.S.

Luseland, Sask.—Hisey and O'Bready, Kindersley, Sask., have been awarded contract for extensions to telephone system.

Magog, Que.—Thos. P. Charleston, Ottawa, has been awarded contract by the department of public works for repairs to wharf.

Ottawa, Ont.—George Roberts, 77 Lagauchetiere St. W., Montreal, has been awarded contract for screens, panelling and woodwork at the new parliament buildings, Ottawa.

Ottawa, Ont.—Tenders will be received until July 9th for rubber flooring required in construction of parliament buildings. Official advertisement in this issue.

Port Arthur, Ont.—The department of public works, Ottawa, has awarded contract for repairs to temporary pile protection breakwater to the Barnett-McQueen Co., Ltd., Port Arthur, Ont.

Toronto, Ont.—Tenders will be received until July 15th, by T. L. Church, chairman, board of control, for the complete supply and erection of metal fire escapes on the isolation hospital buildings of the city of Toronto. Specification and blue print may be seen and tender form obtained, together with all information pertaining thereto, at the office of the property department, City Hall, Toronto.

Victoria, B.C.—Tenders will be received by the minister of lands until noon, July 10th, for the construction and completion of approximately eight miles of main irrigation canal from the point of diversion on Okanagan River. Plans, specifications, contract and forms of tender may be seen at government agent's offices at Fairview and Vancouver, and at the water rights branch, Victoria. E. A. Cleveland, consulting engineer to the department of lands.

Winnipeg, Man.—Tenders will be received until July 10th, by Geo. A. Grierson, minister of public works, for assembly and erecting materials in connection with construction of transmission line between this city and Portage la Prairie. Official advertisement in this issue.

The Canadian Engineer

A Weekly Paper for Civil Engineers and Contractors

Making Concrete Blocks for Toronto Breakwater

New Plant Located on Toronto Harbor Commissioners' Reclaimed Dockage at Foot of Spadina Ave.—Pouring Concrete Blocks Weighing 10 and 18 Tons Respectively—Special Design of Collapsible Wooden Forms—Economical Handling in Limited Space

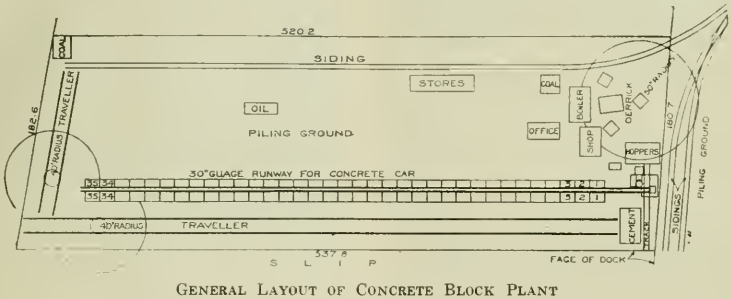
By FREDERICK PHILLIPS
Assistant Engineer, Roger Miller & Sons, Ltd., Toronto

THE plant described herewith was erected for the purpose of making the large concrete blocks used in connection with the cribs laid between the Western gap and the Humber River, Toronto, to form a breakwater approximately four miles long and which in turn forms a part of the complete harbor improvement scheme.

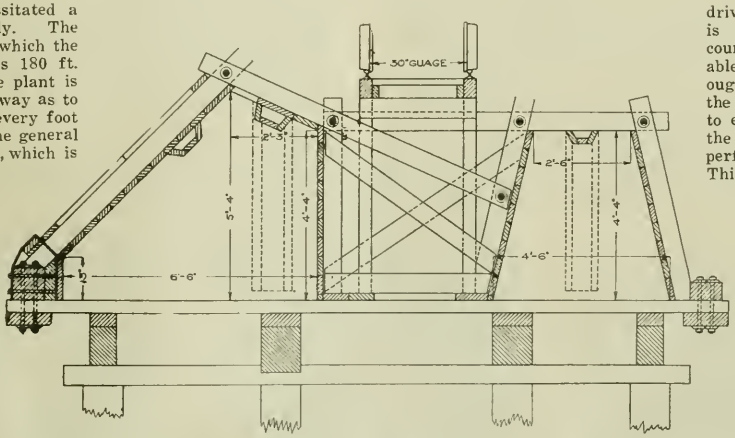
The plant is located at the south end of Spadina Ave., with a slip 200 ft. wide on the east side and the open bay to the south.

The effort to provide a layout that would be economical and at the same time enable the entire area of the plant to be used, necessitated a very careful study. The size of the lot on which the plant is located is 180 ft. by 538 ft. and the plant is utilized in such a way as to make practically every foot of it valuable. The general layout of the plant, which is shown by the accompanying illustration, will demonstrate this.

The position of the mixing plant is such that the material can be handled very conveniently. The stiff leg derrick is set at a height above the general car level to allow the operator to see the car that is being unloaded, and is set in such a position that it will reach across on either side and dump into the material bin or into the triangular storage space between the two tracks, providing ample storage within a very small radius. The cement storage was placed on the opposite side of the mixing plant, so as to be convenient for unloading cement either from boats or cars.



GENERAL LAYOUT OF CONCRETE BLOCK PLANT



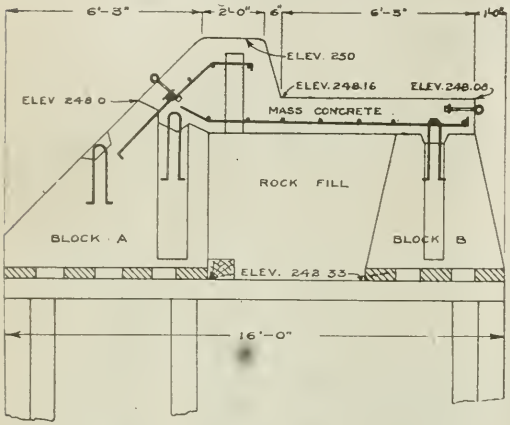
CROSS-SECTION OF COLLAPSIBLE FORMS USED IN CONSTRUCTING CONCRETE BLOCKS

The cement is conveyed from this shed to the mixer on small cars at such a level that it will dump into bucket or hoist conveniently. The material is then hoisted and dumped into a batch hopper on the side of the tower, which in turn desposits into a Smith steam-operated 1-yard concrete mixer and is discharged directly from the mixer into the cars. These side-dump cars are of special design and run along a narrow gauge track between and above the forms, and are operated by an endless cable.

The forms are built on a platform 4 ins. thick and supported on beams and piles driven to rock. This is necessary on account of not being able to get a solid enough foundation on the made ground so as to ensure the floor of the forms being kept perfectly straight. This platform is 400 ft. long, 20 ft. wide and rests on 148 piles. Located above the centre of the platform and running the entire length is a light trestle framing which supports the car tracks and is sheeted on either side to form the backforms of the blocks, thus making a continuous wall. The forms are made of 1¾ in. spruce, 3 ins. by 6 ins. and 4 ins. by 6 ins. studding, and are all connected with bolts and angles with slotted holes so that the forms can be released about 1 in. away from the blocks without entirely removing them, after the concrete has set from 12 to 24 hours. This gives a free circulation of air without allow-

ing the hot sun to strike the concrete and materially assists in the drying and hardening. The parts of forms are all interchangeable and are set to permanent gauge forms located on floor and back wall, thus making it unnecessary to sort out forms when stripping or replacing. The forms are arranged in pairs similar to the position they will occupy when permanently set on the cribs. The large blocks which are placed on the lake side of the breakwater contain 8.9 cu. yds. of concrete and weigh 18.04 tons, while the smaller blocks which go on the shore side contain 5.25 cu. yds. and weigh 10.6 tons. No reinforcing is used in these blocks but keys and rods are provided for the anchors for the mass concrete which is formed on top of these and there are also U-bolts set in the blocks for lifting purposes.

Between the forms and the slip a 20-ton travelling derrick on a 12 ft. gauge track is located to handle forms, lift blocks and transfer to scows from whence they are



Cross-Section of Superstructure of Breakwater, Showing Mass Concrete over Concrete Blocks

towed to the location of the breakwater, where they are set by a derrick scow especially equipped for the job.

At the south end of the dock is a 10-ton travelling derrick for loading the one-man stone to be placed in the cribs.

The plant is well provided with the necessary smaller buildings, blacksmith shop, stores, office, carpenter shop, etc.

The plant is capable of pouring 200 cu. yds. per 8-hour day, which is equivalent to about 14 of each size of block. The entire plant and equipment, including the derricks, was built by Roger Miller & Sons, Ltd., and designed and supervised by A. E. Gibson of the same firm.

At a recent meeting of the branch of the Engineering Institute at St. John, N.B., the following resolution was passed: "Whereas, the people of Canada are confronted with the problem of carrying the very heavy national debt incurred by their participation in the great war for humanity, and whereas this burden can be borne only through the greatest thrift and industry on the part of the nation, through the conservation and development of our human and natural resources, so that we may be able to share in the world's markets against the strong competition that we shall have to meet, be it therefore resolved that the St. John Branch of the Engineering Institute of Canada do hereby declare their heartiest support of the establishment by the government of Canada of a National Research Institute, which shall carry on and direct research into such industrial, agricultural, commercial and medical problems as will best promote such conservation and development of Canada's resources, and that copies of this resolution be sent to the council of the Institute to be forwarded to the government."

ADVANCE IN CHLORINATION AND ITS EFFECT ON TYPHOID FEVER*

By John Kienle
Sanitary Engineer, Electro-Bleaching Gas Company, New York City

Chlorination of public water-supplies has been the most noteworthy single contribution to the art of water purification in recent years. The effect of this method of water treatment in reducing the typhoid mortality of the country at large is attested not only by the statistics but by the increasing demand of public health authorities for this method of protection.

Chlorination of water by the hypochlorite of lime method was first carried out successfully in the United States by George Johnson at the Union Stock Yards at Chicago in 1907, and almost immediately followed by the treatment of the Jersey City supply at Boonton. By the end of 1911, approximately 500 water plants had been equipped with hypochlorite installation. In 1912, the use of liquid chlorine was announced at the Minneapolis convention of this association. Although the increase in the use of hypochlorite was quite rapid following its appearance at Boonton, the rate of growth of the liquid-chlorine process was even more remarkable. From only one water plant (Niagara Falls), equipped at the end of 1912, the number at the end of 1918, had jumped to approximately 2,500.

In 1907, the United States Census Bureau tells us, the typhoid-fever death rate in the registration area, with a population of 41,758,000, was 30.3 per 100,000, and the estimated number of deaths within the year for the entire country was approximately 30,000. There were then no chlorinated water-supplies. In 1917, according to the United States Public Health Service, the rate had dropped to 12.3 per 100,000, with the estimated number of deaths stated at 13,000, and in this year there were at least 2,000 public water-supplies that were chlorinated. Thus 17,000 lives were saved from death by typhoid in one year. This is a saving of over $125,000,000 annually.

It has been aptly stated that the chlorination of public water-supplies is the cheapest municipal insurance that can be obtained, the average annual premium amounting to not more than 40c. per 1,000,000 gals. of water treated, or, for a municipality of 5,000 or less, an annual expense of $150 per annum ($36.50 operating, and $120.00 depreciation at the rate of 20%) or a cost of 3c. per capita, based on the same figure of 5,000 population.

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*From address before the American Water Works Association.

Wanted, copies of the June 5th, 1919, issue of *The Canadian Engineer*. Any subscribers who have no further use for their copies are requested to forward same to the Circulation Department, *The Canadian Engineer*, Toronto.

The Federal Highways Bill has passed through the committee of the House of Commons. Under its provisions, each province will receive an initial grant of $80,000. The balance of the $20,000,000 will be awarded to the provinces on a basis of population.

In discussing Mr. Breed's paper on concrete in road, culvert and bridge work, which was read at the good roads convention in Quebec, E. Drinkwater, consulting engineer, of Montreal, inquired regarding the use of box sections for culverts instead of pipe, asking whether Mr. Breed had not experienced trouble with water getting into the pipe and freezing. He also asked whether the 1:3:5 mix had been found suitable for box culverts. Mr. Breed said that he had experienced some difficulty in connection with concrete pipe culverts along the lines indicated by Mr. Drinkwater. He thought that a better mixture for the box culverts is 1:2½:5. The United States government specifies 1:2:4, but the New York State Commission prefers 1:2½:5 as giving the best results, and the only two failures that they have experienced in three years in using this mix were from dirty aggregate.

AIR-LIFT PUMPING

By John Oliphant
Manager, Air-Lift Pumping Dept., Sullivan Machinery Co., Chicago

WHILE I am not going to enter at this time into the principles of air-lift pumping, I would like to call your attention to the advisability of a perfect emulsion of air and water at the footpiece in order to secure the best economy, and also to lay stress upon the care with which should be calculated the diameters of the water and air pipes for different lifts and different submergences.

While it is a fact that there are several types of mechanical deep-well pumps that, up to certain depths, will give

Well-Head and Separating Tank at Galesburg, Ill.—Air Receiver at the Right

theoretically a higher efficiency than air-lift, yet this difference in efficiency is theoretical rather than practical. It has been demonstrated time and again that air-lift, even with its lower theoretical overall power efficiency, but with immunity from derangement, has been placed ahead of the deep-well pumps under many conditions of operation.

The village of Maywood, a suburb of Chicago, has a compressor handling a single well, pumping at the rate of 700 gals. per min., with a lift of over 300 ft. This compressor has been operating for

Belt-Connected Air Compressor at Galesburg, Ill.

Air-Lift Booster at Maywood Water Works

Discharge into Weir Box over Concrete Storage Basin at Galesburg, Ill.

four years, 24 hours per day, with a stoppage of only a few minutes during the 24 hours for necessary examination and adjustments. This plant has been operated at the above capacity continuously at absolutely no cost for repairs and no shut-downs, except those above indicated. I believe this would compare favorably with the operation of a mechanical deep-well pump even at its higher rated efficiency.

There are a great many occasions where the air-lift can be used as an auxiliary to a high-duty suction plant pumping from deep wells. Such a case came up over a year ago at Clinton, Ill., where they secure their water by suction from deep wells, and for ordinary purposes secure a sufficient amount by this method. But in case of peak loads in the summer, and in case of fire, it was found that the supply secured by suction was not sufficient to cover their requirements.

The supply is secured from some half-dozen wells, having a surface flow of limited volume. These are connected so as to flow into a surface reservoir, or may be direct-connected to mains by means of suction pumps. Experience showed that when suction was resorted to, the supply for

Flushing a Well at Clinton, Iowa

the summer hot weather load, or for an extended fire demand, was insufficient. Three of the wells were therefore connected with an air-lift system arranged to discharge into the reservoir, using the suction piping as a gravity flow line.

A suitable arrangement of valves is provided to permit this flow from the wells to the reservoir, while the service pumps draw their supply from the reservoir by suction. By this arrangement, the water supply was more than doubled from these three wells.

One of the 8-in. wells had a natural artesian flow of about 150 gals. per min. When under suction from the pumps, the pull-down was 20 ft., increasing the flow to 500 gals. per min. When this well was connected up for operation under the air-lift, its production was increased to 1,035 gals. per min., the pumping head being 50 ft. below the surface. The other two wells, connected up in the same manner, showed a proportionate increase.

These wells are handled by means of an air-lift pump suspended on a 2-in. air line in the 8-in. casing. The air for operating the wells is supplied by a straight-line simple steam and compound air compressor, size 14 by 16 by 10 by 16 ins., having a capacity of 558 cu. ft. of free air per min. The installation was effected in a simple and economical manner, piping the air from the receiver to and into the wells. On ordinary service, the pumps secure sufficient supply by direct suction. When an increase is demanded by the summer domestic requirements or by fire, it is merely necessary to start the compressor, throw a few valves, and the supply from the wells is more than doubled.

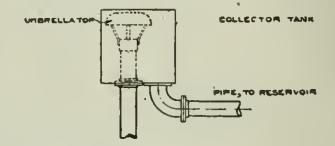
For general information I include below some figures secured from two installations made at Galesburg, Ill. The first of these has been in operation over a year, and the second about six months. These plants are located at different points in the town and centrifugal pumps used to take the water from the service reservoirs and force it directly into the mains. You will notice that the efficiency indicated in these reports is the electric in-put to the motor as compared to footpounds of work done, and includes all motor, transmission and compressor losses, and we believe will compare favorably with the highest type of mechanical pump under the severe lifts obtaining at these installations.

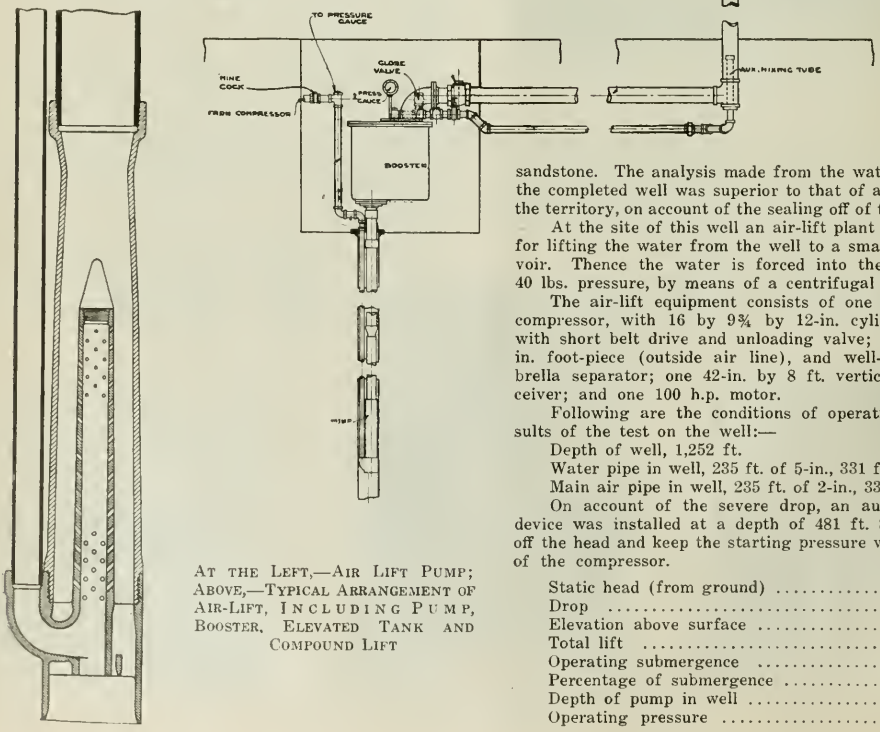
The city of Galesburg, Ill., has had considerable difficulty in securing sufficient water for the public supply. A number of wells in the neighborhood of the old pumping plant have been driven and equipped with various devices, but failed to give the amount of water needed. The old plant consists of three deep and six shallow wells, with a combined yield of about 250 gals. per min., and has been very expensive to operate and maintain, and it was therefore determined to sink a new well.

The construction of this well was as follows: 40 ft. of 24-in. heavy steel casing; 106 ft. of 20-in.; 130 ft. of 16-in.; and 350 ft. of 12-in. steel casing. The 12-in. is sealed in the rock. The hole was then drilled 12 ins. in diameter to a depth of 1,085 ft. from the surface, then reduced to 10 ins. and drilled down to 1,255 ft. through the St. Peter's sandstone formation.

The well was then shot with two 200-lb. charges of 100% gelatin, covering the entire sand rock strata, and carefully cleaned out.

Genuine wrought-iron 10-in. pipe was installed and sealed into the top of the 12-in. pipe, approximately 350 ft. from the surface of the ground. This extends to within 3 ft. of the top of the sandstone strata, hermetically sealing the well from all water in the strata above the St. Peter's sandstone. The analysis made from the water secured from the completed well was superior to that of all other wells in the territory, on account of the sealing off of the upper strata.





At the site of this well an air-lift plant was constructed for lifting the water from the well to a small surface reservoir. Thence the water is forced into the mains against 40 lbs. pressure, by means of a centrifugal pump.

The air-lift equipment consists of one angle-compound compressor, with 16 by 9¾ by 12-in. cylinders, arranged with short belt drive and unloading valve; one standard 5-in. foot-piece (outside air line), and well-head with umbrella separator; one 42-in. by 8 ft. vertical steel air receiver; and one 100 h.p. motor.

Following are the conditions of operation and the results of the test on the well:—

Depth of well, 1,252 ft.

Water pipe in well, 235 ft. of 5-in., 331 ft. of 6-in.

Main air pipe in well, 235 ft. of 2-in., 331 ft. of 2½ in.

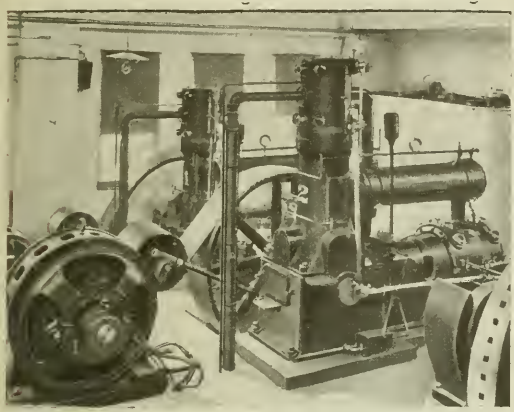
On account of the severe drop, an auxiliary starting device was installed at a depth of 481 ft. 8 ins., to pump off the head and keep the starting pressure within the range of the compressor.

Static head (from ground)	186 ft.
Drop	118 ft.
Elevation above surface	7 ft.
Total lift	311 ft.
Operating submergence	262 ft.
Percentage of submergence	45.8
Depth of pump in well	566 ft.
Operating pressure	121 lbs.

At the Left,—Air Lift Pump; Above,—Typical Arrangement of Air-Lift, Including Pump, Booster, Elevated Tank and Compound Lift

Starting pressure with auxiliary	129 lbs.
Gallons per minute pumped	450
Actual cu. ft. free air used per min.	450
Revolutions of compressor	179
Water h.p. (that is, ft. lbs. of work done)	35.5
Operating horse-power	94
Efficiency, per cent.	37.5

The efficiency shown is considered excellent, and this result was made possible by careful proportioning of the sizes of air and water piping, proper location of the footpiece or pump in the well, and by the use of improved footpieces, providing a continuous flow of water. In this design the air is discharged from the footpiece into the water in the well casing in a multitude of fine jets, creating a very thorough mixture or emulsion of air and water. This action



Compound Air Compressors, with Short-Belt Motor Drive, at Maywood Water Works

secures the maximum efficiency, as the chance of slippage is reduced to the minimum.

The figures on the second plant, known as the Bradley Well No. 2, are as follows and are taken from a test on March 8th, 1919:—

Depth of well, 1,245 ft.

Diameter, 360 ft. of 15-in., 250 ft. of 14¼-in., 635 ft. of 13½-in.

Water pipe in well, 204 ft. of 8-in., 213 ft. of 7-in., 190 ft. of 6-in.

Main air line, 600 ft. of 3-in.

Auxiliary line, 500 ft. of 1½-in.

Conditions of operation:—

Static head from ground	190 ft.
Drop	157 ft.
Elevation above surface	7 ft.
Total lift	354 ft.
Operating submergence	253 ft.
Percentage of submergence	41.75
Depth of pump in well	600 ft.
Operating pressure	115 lbs.
Shut-in pressure	110 lbs.
Starting pressure with auxiliary	135 lbs.
Gallons per minute pumped	650
Actual cu. ft. free air used per min.	719
Displacement	883
Revolutions of compressor	214
Water h.p. (that is, ft. lbs. of work done)	58.2
Operating air h.p.	148
Efficiency of air compressor compared to work done, percentage	39.3
Estimated in-put efficiency, percentage ..	35.8
Estimated motor efficiency, percentage ...	91

Attention is called to the advantage of air-lift pumping in the case of wells, the waters from which, in order to make them suitable for domestic or other purposes, require treatment for the elimination of sulphates or carbonates of iron in solution, or other impurities which can be oxidized and precipitated by aeration and then removed by filtration.

In this method of pumping the compressed air is forced into and comingled with the water at the bottom, or at least deep in the well, by means of a multiplicity of fine streams or jets, ensuring the most intimate mixture of the air and water, every particle of the water being permeated with air as it rises in the eduction pipe. Oxidation and precipitation of the iron solution thus takes place with the greatest possible rapidity, and it is then a simple matter to remove it by filtration. Waters containing carbonate of iron are especially susceptible to treatment in this manner, the pumping operation at the same time serving the purpose of freeing the dissolved iron so that it may be removed by the filter without even intermediate sedimentation.

The treatment of waters containing sulphates of iron are more difficult, and the use of ample sedimentation tanks or basins ahead of the filter are advisable. In some cases aeration must be supplemented by the feeding of a very small quantity of lime into the water to accelerate sedimentation, but in any event the thorough aeration of the water in the pumping operation is a very important and vital adjunct to the purification process.

Combined air-lift pumping and purification plants can be arranged in many different ways, according to local conditions. In some cases the air-lift merely delivers the water to a sedimentation tank combined with a filter located at the surface and as close to the well as practical, the effluent from the filter flowing by gravity to a surface reservoir or sump, whence it is forced by piston or centrifugal pumps into the service system, or to a service tank or reservoir located at a suitable elevation.

In other cases, where the well or wells are deep enough to provide the necessary submergence, and other conditions are right to utilize the air-lift (by means of an air-lift booster and re-lift jet) to lift and force the water in one operation from the wells to the elevated storage reservoir, this reservoir or tank also acts as a sedimentation tank, and the water can pass from it through a pressure filter into the service pipes.

A third arrangement is where the pressure filter is placed in the line between the well and the elevated reservoir, and the water lifted and forced by the air-lift in one operation from the well through the filter and up to the elevated service reservoir.

I would like to call special attention to the two latter arrangements as it is my observation that the possibilities of the air-lift, as a means of forcing the lifted water to a point beyond the well-top, are not generally realized. While this method has its limitations, there are many situations where it can be used to advantage, eliminating the complication of a separate pump, with its incidental surface suction-basin for this service.

In the boosters generally used in these installations the discharge from the well is brought to a complete stop by striking an umbrella separator in the booster throwing the water to the bottom of the booster and allowing the air to escape from the top. Owing to the complete emulsion of the air and water, considerable of the air is carried over in the discharge from the booster, and, while this is of benefit where filtration is to be used as above described, it becomes detrimental where this class of booster is discharged into long horizontal lines, on account of the air pocketing in the high points, and also where the discharge is to be carried directly to pumps or condensers.

In order to overcome the difficulties above mentioned, and to ensure perfect separation of the air and water, a separator has been designed which consists of a simple shell, or cylinder, with top and bottom. The combined air and water is discharged into the top and at one side, at a tangent to the periphery, under high velocity from the well, causing it to swirl, and effecting a perfect separation of

the air and water, the water leaving the separator from an outlet at the bottom, tangent to the periphery, and the air passing off at the top. The downward centrifugal action leaves the air quite dry and frees the water entirely from air bubbles.

By this centrifugal arrangement the water is not brought to a dead stop and reversed, with consequent loss of all momentum, as in some older types of boosters, but its direction is gradually changed so that it is carried on to the outlet of the separator without loss of momentum and with proportionately greater efficiency.

PENETRATION "SLIDE RULE"

TO facilitate the determination of the proper penetration of asphalt for various classes of paving, J. R. Draney, sales manager of the United States Asphalt Refining Co., of New York, has devised a "slide rule" which gives the correct answer at once for any given condition. This "rule" is patented and has been manufactured in celluloid by Mr. Draney's company, and is being distributed gratuitously to paving engineers and road contractors. It is very neatly arranged and forms a handy paper weight as well as a ready means of determining penetration.

The "rule" is circular, 4 ins. in diameter, about ½ in. thick and weighs 7½ oz. There are three circular, concentric scales, the inner two having openings through which the readings are taken.

The outer scale is fixed, the circle being divided into four portions, covering (1) asphaltic concrete (Topeka), (2) asphalt macadam (hot mix), (3) penetration construction and (4) sheet asphalt.

The middle scale can be revolved so as to be placed in proper adjustment with the outer scale. The middle scale is divided into three parts: (1) high temperatures, (2) moderate temperatures, and (3) low temperatures.

The innermost scale also revolves, and likewise is divided into three parts, (1) heavy traffic, (2) moderate traffic and (3) light traffic.

The instructions for using the "rule" are as follows:—"Select the quadrant or the outer dial showing the type of construction, then turn the intermediate dial until appropriate temperature conditions are in register. Now turn the centre dial until the sector showing the proper traffic conditions registers with the two outer sectors. The number appearing in the opening in the quadrant originally selected is the number or grade of asphalt to be ordered."

Following are all the readings that can be obtained from the rule:—

Pavement	Temperature	Traffic	Penetration Grade No.
Asph. Conc.	High	Heavy	55
"	"	Mod.	55
"	"	Light	55
"	Mod.	Heavy	55
"	"	Mod.	55
"	"	Light	65
"	Low	Heavy	65
"	"	Mod.	65
"	"	Light	75
Asph. Mac.	High	Heavy	65
"	"	Mod.	75
"	"	Light	75
"	Mod.	Heavy	65
"	"	Mod.	75
"	"	Light	75
"	Low	Heavy	75
"	"	Mod.	75
"	"	Light	85
Penetration	High	Heavy	85
"	"	Mod.	85
"	"	Light	85
"	Mod.	Heavy	110
"	"	Mod.	110
"	"	Light	110
"	Low	Heavy	150
"	"	Mod.	150
"	"	Light	150
Sheet Asph.	High	Heavy	45
"	"	Mod.	55
"	"	Light	55
"	Mod.	Heavy	45
"	"	Mod.	55
"	"	Light	55
"	Low	Heavy	55
"	"	Mod.	55
"	"	Light	65

The permissable variations in penetration of the different grades of asphalt are given as follows:—

Grade No.	Range in Penetration
45	40 to 50
55	50 to 60
65	60 to 70
75	70 to 80
85	80 to 90
110	100 to 120
150	130 to 170

SUPPLEMENTARY ESTIMATES

SIR Thomas White, Minister of Finance, announced on Thursday, July 3rd, in the House of Commons, supplementary estimates, amounting to $36,723,120, of which $23,494,256 will be charged to current revenues and the remainder to capital account. Following is a partial summary:—

Harbor Work	
Champlain, drydocks	$ 207,000
Collingwood, breakwater	50,000
Depot Harbor, wharf	34,000
Esquimalt, drydock	500,000
Fraser River, dredging	50,000
Hamilton, harbor improvements	100,000
La Prairie, Que., protection	82,000
Little Current, wharf	54,000
Nicomen Island, improvements	36,000
Owen Sound, wharf	86,000
Port Arthur and Fort William, harbor improvements	200,000
Port Dover, harbor improvements	50,000
Port Stanley, harbor improvements	33,000
River St. Charles, improvements	55,800
Shipbuilding	10,000,000
St. John, harbor improvements	250,000
Sydney, N.S., wharf	100,000
Thessalon, breakwater	48,000
Toronto breakwater protection	200,000
Toronto, harbor improvements	200,000
Vancouver, harbor improvements	18,000
Victoria, harbor improvements	21,000
Bridges	
Edmundston, N.B., across St. John River	$ 25,000
Hamilton, across Burlington Channel	100,000
Railway Construction	
Edmonton, Dunvegan and British Columbia subsidy—Spirit River through Grand Prairie	$ 258,797
Hudson Bay	300,000
Quebec and Saguenay	550,000
Public Buildings	
Kamloops, B.C., postoffice, etc.	$ 20,000
London, Ont., postoffice, etc.	400,000
Montreal, postoffice	24,000
Oshawa, Ont., postoffice, etc.	23,000
Portage La Prairie, Man., improvements	25,000
St. Catharines, additions	28,000
Toronto, postal station A	115,000
Winnipeg, postal station A	10,500
Miscellaneous	
Federal Department of Health	$ 200,000

WORLD'S MOST POWERFUL PRIME MOVER

Is Triple, Cross-Compound Steam Turbine Installed in New York Power-House—Rated at 70,000 k.w. Capacity for Two Hours

By A. B. Cole
Westinghouse Mfg. Co., Pittsburgh, Pa.

In its 74th St. power-house, the Interborough Rapid Transit Co. of New York recently placed in operation a turbine that is remarkable for two reasons. In the first place, it is rated at 60,000 k.w. capacity continuously, and 70,000 k.w. for two hours, so it is the most powerful prime mover in the world. Secondly, it has three elements—one high pressure and two low pressure, and is the first triple cross-compound turbine to be placed in operation.

The purpose of this huge machine is to assist in meeting the greatly increased demand for transportation in New York City, due to the opening up of a new subway system, and the extension of the service of the existing subway, elevated and surface lines.

The rapidity with which the Interborough's power requirements have increased in the past few years is indeed extraordinary. In 1904, the 74th St. station contained nine reciprocating engines driving direct-current generators rated at 5,000 k.w. each. This amount of power sufficed for a while, and then in 1913 it became necessary to remove four of these engines and install in their place three compound 30,000 k.w. turbines.

Though 90,000 k.w. was thus substituted for 20,000 k.w., this increase was hardly obtained when it in turn became insufficient. Now 70,000 k.w. more is added, and probably additional units will again be needed in the not distant future.

The new unit occupies a floor space of 52 by 50 ft., and is about 19 ft. high. The high pressure element receives steam at 205 lbs. gauge pressure, and superheated 150° F., and exhausts it into the low pressure elements at 15 lbs. gauge pressure. The two low pressure elements are identical in construction, and each receives one-half of the steam from the high pressure element and exhausts it into the condenser where a 29-in. vacuum is maintained. All three elements operate at 1,500 r.p.m., and each drives a generator rated at 20,000 k.w. continuously, 23,500 k.w. for two hours, and 30,000 k.w. for a half hour. The generators deliver three-phase, 25-cycle, 11,000-volt alternating current.

Though consisting of three separate elements, the entire machine is started, synchronized and controlled as a single unit. At the same time, any one or two of the elements can be shut down without interfering with the remainder, so that the high efficiency of a single large machine is combined with the flexibility of three smaller machines. In addition, the three small elements are mechanically much stronger than a single large one would be; the temperature differences in any cylinder are considerably less, and commercially common materials, with moderate blade speeds and stresses, can be used.

Close-Up View of the Triple Compound Turbine

All of the turbines are of the pure reaction type, without the usual impulse elements, as this construction is considered preferable in view of the great volumes of steam to be handled. The high pressure turbine is of the single-flow type, and is made of of cast steel. The low pressure turbines are of the semi-double flow type; that is, the steam enters near the centre of the turbine and flows as a whole through a portion of the blading, and then divides into two portions, each of which flows through a separate section into the condenser. Since the low pressure turbines must receive high high pressure steam in case the high pressure turbine is shut down, the central portions of these turbines are made of cast steel also. All three rotors are equipped with thrust bearings in order to prevent axial movement.

The generators are so connected to the bus bars that any combination of them can be operated in parallel. In practice, however, all three are brought up to speed together, and synchronized through a single oil-switch connecting the generator busses to the main bus. Reactance coils are installed between the various busses, which limit the amount of current that can flow between the generators. Should a short circuit develop in any of the feeder circuits, or a burn-out occur within a generator, the generator affected is disconnected from the busses by a circuit breaker without interfering with the operation of the other generators.

The method of synchronizing the generators is as follows:—

60,000 k.w. Triple Compound Unit Furnishing Power for Subway, Surface and Elevated Railways of New York—70,000 k.w. Capacity for Two Hours

INTERBOROUGH RAPID TRANSIT CO.'S 74TH ST. POWER HOUSE—30,000 K.W. CROSS-COMPOUND UNIT IN FOREGROUND, NEW TRIPLE COMPOUND UNIT IN CENTRE, AND OLD 5,000 K.W. ENGINE-DRIVEN UNITS IN REAR

The field current is first applied to all of the generators, and then the throttle valve of the high pressure turbine is partly opened. As soon as the high pressure rotor starts revolving, it will start the rotors of the low pressure turbines through the field current. All three then come up to speed together in correct phase with each other. They are then synchronized with the system and connected to it by closing a single circuit breaker.

The governing mechanism must not only control the unit as whole, but also each turbine operating separately. Some of the operations performed by the governors are as follows:—

If serious electrical trouble develops on the circuit of one of the generators of the low pressure turbines, a circuit breaker will disconnect this generator from the bus bars. Relieved of load, the turbine begins to speed up, but before its speed has increased 4%, its governor shuts off the steam supply from the high pressure turbine. This, of course, raises the back pressure of the high pressure turbine, and a back-pressure valve opens, allowing part of the exhaust from the high pressure turbine to pass into the atmosphere while the remainder goes into the other low pressure turbine.

In the meantime, the first low pressure turbine, being without steam, shuts down. When its speed reaches 3% below normal, the governor admits high pressure steam, and the turbine continues to operate at this speed until the switchboard operator either shuts it down or restores normal conditions.

Should the generator of the high pressure turbine be cut out of circuit, the governor cuts off practically all the steam to the entire system, leaving just a sufficient flow to maintain the speed of the high pressure turbine now without load. The speed of the two low pressure turbines decreases, and when the frequency drops 3%, the governor admits high pressure steam direct to the low pressure turbines, which then continue operating. The switchboard operator can now either restores matters to normal or shut down the high pressure turbine.

Each turbine also has an emergency stop which will operate automatically in case the governor fails and the turbine begins to race, or it can be tripped by the switch board operator.

When one of the turbines fails with the entire unit heavily loaded, the governors permit each of the remaining turbines to carry the maximum load of 30,000 k.w. This can be maintained for a half hour, which is regarded as sufficient time to get other generators into operation, and thus relieve the overloaded turbine.

The condenser equipment consists of two 25,000 sq. ft. surface condensers for each low pressure turbine. There are four circulating pumps, three Le Blanc air pumps and four condensate pumps. All of these pumps are turbine-driven (the air pumps directly and the others through gears), and all are so arranged that one or more can be put out of service without interfering with the operation of the condenser.

The steam consumption of the entire unit at its point of best efficiency is 10.7 lbs. per kilowatt-hour. The pressure turbine and one low pressure turbine, operating together, consume 12 lbs. of steam per k.w.h., and one low pressure turbine alone consumes 14.25 lbs. The total steam consumption at full load is 826,000 lbs. per hour.

LARGE STEEL INDUSTRY FOR TORONTO

ACCORDING to information given out by R. Home Smith, Toronto is to have a steel and metal plant on the site of British Forgings at Ashbridges Bay, with a capital of $3,000,000. Mr. Smith said: "After much trouble and negotiating we have persuaded Messrs. Baldwins, of Swansea, Wales, to found a plant of steel sheets and other metal products, valued at between $2,000,000 and $3,000,000, on the site of the British Forgings. At the initial stages 2,000 men will be employed, and there is no reason to doubt that ultimately employment will be given 10,000 men."

EDMONTON PUBLIC UTILITIES IMPROVING

EDMONTON public utilities show a net surplus for May of $2,345, compared with a net deficit for the same month last year of $3,549. The net surplus for the five months (inclusive of the street railway deficit) amounts to $62,233, against $33,809 for the corresponding period of 1918. Net surpluses for the five months of the respective departments are as follows:—

	1919.	1918.
Electric light	$ 66,056	$54,131
Telephone	21,356	13,845
Waterworks	14,246	10,746
Total	$101,659	$78,724

The street railway deficit is $39,425, as compared with $44,914 last year, leaving, as already stated, a net surplus of $62,233 on the combined utilities, as compared with $33,809 in 1918.

THE RELATION OF DEPRECIATION TO INVESTMENT*

By W. C. Hawley
Chief Engineer and General Superintendent, Pennsylvania Water Company

THIS is a subject which, until recently, has received very little consideration from the management of most of our water companies. It was looked upon as theoretical, rather than a real thing seriously affecting the finances of the companies. Not many of our accountants and managers knew how to compute depreciation and very few water companies actually created and maintained a depreciation or replacement fund. We are only beginning, under public regulation, to realize the vital necessity of doing so.

Those of us who have owned automobiles for a few years have received practical and personal demonstration of the reality of depreciation. The machine that cost $2,000 last year can be insured for only $1,500 or less this year, and in from three to five years it must be replaced by a new one. It goes as part of the game; and when a new car is necessary, we will write a cheque or mortgage the house and pay no more attention to it. But suppose by way of illustration, that a man in moderate circumstances invests his savings, and perhaps some money which he has to borrow, in an automobile and starts to operate a jitney or express route. Let us assume that he has no bad luck or accidents and that his earnings are sufficient to pay for gasoline, oil and repairs and give him and his family a living. At the end of five years we will assume that the jitney has to be scrapped. Then, unless the owner has been setting aside from his earnings year by year a proper amount of money as a depreciation fund, he finds himself worse off than when he started. He has nothing to represent the savings which he put into the machine and the money he borrowed. His "plant" has been wiped out. He has no fund to replace it, and if he is to continue in business he must find new capital. This is only an illustration, but the principle is as true and operates as surely in the case of the property of a water works company or any other utility as it does in the illustration given. It is not only recognized in our public service company laws, but, as we shall see, public service companies have been severely penalized in the past because they have not provided depreciation or replacement funds.

Definition of Depreciation

It is not necessary to consider carefully worded definitions of depreciation. Our chief difficulty is that the word has been used with so many different meanings. Depreciation as it affects us, is the reduction in value of our plants, due to age or change of conditions. There are various ways of estimating it, as the "straight line" method, "the sinking fund" method, the "equal annual payment" method, etc. When estimated for the period of one year it is spoken of as "annual depreciation," and when this depreciation is summed up for a period of years equal to the age of the unit considered, or the average age of the plant, we arrive at what is known as "accrued depreciation." Subtracting accrued depreciation from the original value of the plant, however that may have been computed, gives us the depreciated or present value of the physical plant.

What have we been doing in the past regarding depreciation? Many of us nothing, and most of us who have done anything have merely "charged off" depreciation. That is, year by year a certain amount has been added to the operating expenses and either the plant account reduced that much or a corresponding liability set up which was equivalent. Thus year by year the assets of our companies have been reduced and unless, through excessive dividends an equivalent amount was returned to the stockholders, there has been no return to them of that portion of the original investment. In many cases the amount charged off as depreciation has been left in the business and practically it has been reinvested in the plant. The author will discuss this situation later.

The practical result of not creating a depreciation or replacement fund has been that when water works plants have been valued by the public service commissions, the historical cost has been determined where possible and also the cost of reproduction new, and from these and other considerations the value of the plant has been determined and from that figure the accrued depreciation has been subtracted. The Pennsylvania Public Service Commission, in the Beaver Valley Water Co. case, subtracted an accrued depreciation of $215,175.11 from a "fair value new" of $1,187,286.11, which included, however, depreciable property to a value of $1,132,500.60. In the Ohio Valley Water Co. case $88,661 accrued depreciation was subtracted from the reproduction cost of $1,083,825 (which included $10,000 working capital) while from the original cost of $841,343 accrued depreciation of $58,149 was subtracted. In the Westmoreland Water Co. case, from an original cost (including working capital of $10,000) of $1,266,292.51, accrued depreciation amounting to $185,701.85 was subtracted. This was the amount of depreciation which had been charged off on the books of the company and which had been estimated upon a valuation much higher than allowed by the commission, but it was not reduced accordingly. From a reproduction value of $1,373,904.54, estimated accrued depreciation of $122,641 was subtracted. Thus we see the original investment reduced from 5 to 19 per cent.; although not one dollar of this original investment has been returned to the stockholders. In the Westmoreland Water Co. case, counsel for the Water Co. attempted by argument to convince the public service commission that such a reduction was unjust. As a matter of fact, the money had not been taken out of the business, but had been invested in new plant to meet the public's demands for additional service. The practical condition was no different from what it would have been if the company had established a depreciation replacement fund by paying to a trustee or commissioner the amount charged off annually to depreciation and borrowing that money from the trustee, giving therefor the company's note and paying interest upon the money so borrowed. In a substantial water company this is probably one of the best methods of handling a depreciation fund. The answer of the commission to this argument was as follows:—

"The argument that the money represented by these charges remained in the plant for the benefit of the public service is not convincing. Some of it may have gone into the plant to offset depreciation, but the fact remains that in the past the company has not maintained a depreciation account, but has charged renewals to operating expenses rather than to such a fund. Practically all of these charges must have gone into extensions and betterments, and hence are included in the total original cost as found by the commission. The money has been returned to the stockholders just as surely as though it had been paid to them in cash. They have built extensions and betterments with the money represented by these charges instead of with new capital, and therefore, under the argument presented by the respondent, the deduction is entirely justifiable."

The flaw in this argument is so manifest that it needs little discussion. There had been little, if any, replacement necessary because of depreciation in the plant of the Westmoreland Water Co. Its original reservoirs, supply mains and distributing system were and are still in service. What few minor items had been charged to operating expenses rather than to the replacement fund, if any, could readily have been deducted and the accounts corrected. The commission admits that "practically all of these charges must have gone into extensions and betterments." If such an expenditure can be considered a return to the stockholders, it follows that merely charging off depreciation is not a sufficient compliance with the principles of good accounting, or with what the Public Service Commission considers to be the proper procedure in such a case. The decision of the commission not only wipes out for rate making purposes the cost of additions to plant since it was originally built, to the amount of the accrued depreciation, but it leaves the water

*Read before the Pennsylvania Water Works Association.

company without a depreciation or replacement fund. To demonstrate this statement let us put the facts into the shape of a formula, assuming that a depreciation fund had been created:—

Let P = original cost of plant.
Let A = additions to plant paid for from charges to depreciation.
Let a = additions to plant paid for by capital other than from charges to depreciation.
Then $(A+a)$ = total cost of additions to plant.
Let D = accrued depreciation.
Let F = depreciation or replacement fund.
Let I = total investment.

Then we will have

$$I=P+(A+a)-D+F$$

Since D and F are equal, this equation reduces to

$$I=P+(A+a)$$

In other words, the original investment in plant and additions thereto has been maintained. Since no fund has been created, the Public Service Commission says:—

$$I=P+(A+a)-D$$

Assuming that the amount D has been completely expended in additions A
we have

$$A=D$$

and hence

$$I=P+a$$

This shows clearly that the company's investment has been reduced by the amount of depreciation charged off, and that the company has no asset to offset this loss. Surely this is not justice and does not accord with the decision of the United States Supreme Court in the Knoxville Water Co. case which is quoted later.

Setting Aside of Depreciation

Sound business principles require the setting aside of depreciation. The Pennsylvania Public Service Law provides, Article II., Section 1 (i):—

"It shall be the duty of every public service company to carry a proper and reasonable depreciation account, if required so to do by the order of the Commission."

And also (Article V., Section 15):—

"The Commission may, and shall after hearing had upon its own motion or upon complaint, establish by an order to be served, as hereinafter provided, upon every public service company affected thereby, a system of accounts to be used by such public service companies: and may also in its discretion prescribe the manner and form in which accounts, records and memoranda shall be kept by public service companies, including the accounts, records and memoranda of the conveyance of passengers and property and a proper and reasonable depreciation account, . . ."

Uniform System of Accounting

In carrying out these sections of the law, the Public Service Commission under date of March 25, 1918, prescribed and issued a uniform classification of accounts for water companies, in which it provides for the keeping of an account to be known as "Depreciation of Structures and Equipment Reserve." This is on the asset side of the balance sheet, is a subtractive account and is identical with what has been generally carried as "Accrued Depreciation" on the liability side of the balance sheet. The Westmoreland Water Co. was, therefore, carrying a depreciation account such as water companies are now required by the Public Service Commission to carry, and yet the assets of the company were reduced by the amount of that account with no offset, and this was justified by the claim that the money had been returned to the stockholders because it had been invested in extensions and betterments to the plant. Of course, in obtaining the value of the physical plant it was perfectly proper to subtract the amount of accrued depreciation. The gradual reduction in the value of the plant because of depreciation is a fundamental fact, but if the original investment is to be maintained intact, there must be a corresponding asset equal in amount, and this is the depreciation or replacement fund.

By way of illustration of what this may mean to the investors in a water works enterprise, let us assume that the original cost of a plant is $1,000,000, and we will consider that no additions are made to the plant, also that it is a pumping plant of ordinary construction, and that to create a proper depreciation or replacement fund to be invested on a 4 per cent. sinking fund basis, 1 per cent. per year of the original cost of the plant must be set aside. This means an average life for the plant of about forty-one years. Under these assumptions the amount in the replacement fund at the end of each year would be as follows:—

First year	$ 10,000
Second year	20,400
Third year	31,261
Fourth year	42,465
Fifth year	54,163
Sixth year	66,330
Seventh year	78,983
Eighth year	92,142
Ninth year	105,882
Tenth year	120,061
Fifteenth year	200,236

These figures are based upon the assumption that there had been no replacements made. This would probably be true for the first ten or twelve years, and we might then reasonably expect replacements requiring money to be taken from the replacement fund. If, however, at the end of fifteen years this company met with a rate case requiring the valuation of its plant, it will find its plant value reduced by 20 per cent. of the original investment, and according to decisions up to the present, unless it has the equivalent funds in a depreciation or replacement fund it has nothing to offset this loss. This is, of course, upon the assumption that the earnings of the plant have not been excessive and hence there has been no return of this amount, or any part of it, to the stockholders.

Against this method of valuation we have the decision of the Supreme Court of the United States in the case of Knoxville vs. Knoxville Water Co.:—

"A water plant with all its additions, begins to depreciate in value from the moment of its use. Before coming to the question of profit at all, the company is entitled to earn a sufficient sum annually to provide not only for current repairs but for making good the depreciation and replacing the parts of the property when they come to the end of their life. The company is not bound to see its property gradually waste, without making provision out of its earnings for its replacement. It is entitled to see that from earnings the value of the property invested is kept unimpaired, so that at the end of any given term of years the original investment remains as it was at the beginning. It is not only the right of the company to make such a provision, but it is its duty to its bond and stockholders, and, in the case of a public service corporation at least, its plain duty to the public."

Reproduction Cost Less Depreciation

Surely nothing could be plainer than that, and yet, in decision after decision of the various State Utility Commissions, accrued depreciation has been subtracted without any regard to whether or not it has ever been earned, or if earned it has ever been returned to the stockholders.

Arguments in the effort to convince commissions of the correctness of this theory have been made so often, only to be ignored, that it seemed almost as hopeless as the effort to convince the commissions that "going value," "cost of establishing business," or "the value of established business," —whatever one chooses to call it—has a separate and distinct cost and value over and above that of the physical plant. It was, therefore, with surprise and pleasure that the author noted the decision of the Wisconsin Railroad Commission handed down June 1, 1918, in the case of the Milwaukee Electric Railway and Light Co., *et al.*, vs. City of Milwaukee. (P.U.R. 1918-E.) In this decision the commission says:—

"(11) As reproduction cost new is not necessarily to be taken as representing fair value, it seems equally clear that reproduction cost new less depreciation cannot be so taken. What is to be ascertained is the amount fairly representing the prudent and honest investment made by the owners of the utility. They are entitled to have that contribution kept intact until returned to them. In other words, those that have contributed to the utility are, under normal conditions, entitled to a fair return on the amount of such investment while it remains in the utility. Whether that sum be arrived at on the original cost (physical property) or investment basis (and the two may be identical) the investor is entitled to a return on this amount, assuming that no part of his investment has been returned. If this amount, on the other hand, is taken as fairly represented by reproduction cost, the same principle would seem to apply; for reproduction cost less depreciation does not of itself establish the return of any part of the investment to the investor. Reproduction cost new less depreciation can be used as the final measure of fair value for rate making purposes only upon the assumption that the utility has not only earned the sum represented by depreciation in excess of a fair return on the original investment, but has also returned the same to the investors, retaining no depreciation reserve represented by assets. Where reproduction cost less depreciation is used as controlling in determining fair value unless the amount earned to provide for depreciation is returned to investors, it will not usually earn a return sufficient to constitute a fair return on the investment. Where the reserve is provided on a straight-line basis and retained by the utility, any interest earned on assets offsetting the reserve would constitute income of the utility. If the reserve assets are held in the business and the reproduction cost less depreciation is used as a basis for the valuation, a return upon such reproduction cost less depreciation at the normal rate, plus interest earned upon reserve assets, would be less than a fair return upon the investment unless a rate of interest were actually earned upon such reserve assets equal to the rate which constitutes a fair return for the property as a whole. Where reserve assets actually earn less than a fair rate of return upon the investment as a whole, the only way that occurs to us in which investors can obtain a fair return upon their full investment is by earning a higher rate on the cost new less depreciation than would be required if the investment, as already discussed, were used as a basis. Unless the rate of return on the cost new less depreciation is to be enough higher than the rate which should be applied to the investment to bring the total return, which is made up of the return on cost new less depreciation and interest earned on reserve assets, the reserve being provided on a straight-line basis, up to an amount which would constitute a fair rate of return on the investment, we see no way in which the investor, under such a method of valuation would secure a fair return on this investment, unless it is to be assumed that amounts earned for depreciation can be withdrawn from the business and the investment thereby diminished. This principle was fully established in the Knoxville Water Co. case."

Then follows the quotation from the Knoxville case which has been given above.

Understanding of Principles Involved

This is the clearest statement of the principles under consideration that we have seen, and gives evidence that not only are we progressing toward a full understanding of the principles involved in valuation and rate regulation, but that our public service commissions, when convinced of the correctness of a principle, will deal justly with the public service corporations, even to the extent of reversing rulings laid down in former decisions. We may be dissatisfied with some of the things which the commissions have done, but let us remember that they and the utilities are working out a comparatively new proposition which promises much good both for the public and the utilities. We are traversing a path which has only been charted by broad statements of principles in the few legal decisions which have been handed down in such cases. Our courts in the few rate or valuation cases reported have avoided criticism by not giving the details of the calculations by which they arrived at values. Some such statement as "taking into consideration this and that and all of the other matters which bear upon this question, we find so and so" has protected many a valuation from an attack which should have resulted in reversal by the higher courts. The commissions, however, as a rule have wisely adopted the plan of publishing the calculations by which they arrive at values. Some of the calculations are simple and the principles well understood and agreed upon. Others are involved, difficult of determination, with at least some of them still the subject of doubt and disagreement. Depreciation and its treatment in accounting and in valuation and rate making has been one of these. This Milwaukee decision is a milestone on the road of progress.

Definition of Reserve

In the uniform classification of accounts for water companies, prescribed by the Public Service Commission of Pennsylvania, to which previous reference has been made, we find that fixed capital has been divided into two accounts—that installed prior to January 1, 1918, and that installed since December 31, 1917, the latter having been classified in accordance with prescribed accounts, and that the next account, No. 102, is called "Depreciation of Structures and Equipment Reserve." This, as previously explained, is a subtractive account, and in most of our bookkeeping has been called "Accrued Depreciation," and carried as a liability. This liability has been brought to the other side of the page and made a "red asset," by the same principle as that involved in algebra when we take a quantity from one side of the equation to the other, by changing its sign, and do not affect the correctness of the equation by doing so. This is something new to most of us, but it is quite generally approved by expert accountants and is already in use by a large number of our great industrial corporations. The advantage of it is that, by subtracting the account from the total of the fixed capital, there is shown at once the present or depreciated value of the physical plant. The use of the word reserve in this sense is probably unfortunate. The Century Dictionary defines reserve as: "That which is reserved or kept for other or future use; that which is retained from present use or disposal." The fund which is accumulated and set aside to pay for replacements is a reserve or reserve fund, but it is not clear how the accumulated losses in value due to depreciation can be called a reserve. However, the account known as "Depreciation of Structures and Equipment Reserve" is clearly explained in the printed text accompanying the uniform classification.

This explanation states that there is to be credited to this account and charged to account No. 402, "Depreciation," that amount which it is estimated will, through regular application, over the life of the structures and equipment of the various divisions of the utility water system, be sufficient to provide an adequate reserve to cover those expenses of depreciation that accrue upon such structures and equipment. This, and what follows, is clear and easily understood, but unfortunately neither here nor elsewhere do we find any statement regarding a depreciation or replacement fund, and yet, as we have seen, water companies have been practically penalized because they had not established such funds. It would seem as though there should have been provided a special place under the asset accounts for this fund. Inquiry of the Bureau of Accounts and Statistics was answered to the effect that the proper procedure in creating a fund would be to charge account No. 113, "Insurance and Other Reserve Fund Assets," subaccount—"Depreciation Reserve Fund," and to credit account No. 117—"Cash." In other words, the amount charged to depreciation each year is to be taken from cash and put into a depreciation reserve fund or a depreciation replacement fund, which fund is to be carried as a subaccount under account No. 113.

William Morse Cole, in his book entitled "Accounts: Their Construction and Interpretation," gives (page 84) three sample balance sheets, showing methods of treating depreciation, as follows:—

Assets	Balance Sheets		Liabilities
	First year—all plans		
Plant	$90,000	Stock \ Bonds /	$90,000
	Second year—Plan I.		
Plant	$80,000	Stock \ Bonds /	$90,000
Depreciation fund ..	10,000		
	Second year—Plan II.		
Plant	$90,000	Stock \ Bonds /	$90,000
Miscellaneous assets increased	$10,000	Depreciation	$10,000
	Second year—Plan III.		
Plant	$80,000	Stock \ Bonds /	$90,000
Miscellaneous assets increased	$10,000		

Plan II. he calls objectionable and Plan III. seems even worse, and yet most of us have been using either one or the other of them. Commenting on them Cole says:—

"To summarize what has been said of the depreciation fund, then, we find that it may appear on the balance sheet in one of three combinations: (1) among assets only—in which case specific property is set aside to replace or repair machinery, or buildings, or what not, that are thought to have suffered actual depreciation; (2) among both assets and liabilities—in which case specific property is set aside from net income as a safety fund for possible depreciation not thought to be actual; (3) among liabilities only—in which case the amount is deducted from net income and shown on the books as a safety fund for replacement purposes, but the actual property is left among the general assets without specific designation. In the first case the fund could not be distributed to stockholders without impairing capital; in the other two cases the policy might be changed and the fund distributed without affecting capital, though such distribution might be morally and legally unjustifiable as a violation of implied faith."

Straight Line or Sinking Fund?

Our Public Service Commission has adopted Plan I,. and has improved on it by showing plant or fixed capital at its original amount from which is to be subtracted the accrued depreciation, account No. 102, and the depreciation or replacement fund appears as a subaccount of account No. 113.

There is much of interest in Cole's book, which might be quoted here, but only the following paragraph will be added:—

"Has it cost the corporation anything to accumulate this fund? If our real estate and plant are wearing out and are profitably employed, it is obvious that they are reproducing themselves in the annual product. It follows, therefore, that, if the corporation cannot take from the annual product and lay aside as a depreciation fund the equivalent of the annual wear and tear of the real estate and plant, it is running down hill. In other words, that depreciation fund was created, day by day, in the regular product of the business. Real estate and plant, by constant use, have been slowly converting themselves from building and machinery into merchandise. It is the business of the accountant to see that that conversion is recognized and recorded. The surest way to keep it clearly in mind is to take the proceeds from the sale of some of that merchandise and set it aside as a special depreciation fund. Such a depreciation of real estate and plant is loss, of course; but it is loss only in the sense that consumption of raw material is loss; it reappears in the form of goods, and a certain part of the product must be recognized in that form as converted depreciation."

From the foregoing it seems evident that a water company in order to maintain its investment at 100% has the right to earn year by year an amount sufficient to offset its loss by depreciation, and its duty to its stockholders and to the public to set this aside in a fund to take care of replacements as they become necessary. Whether the annual amount of depreciation should be based on the "straight line" or "sinking fund" plan is a matter about which opinion has differed. There are cases where the "straight line" plan should be used, but the consensus of opinion seems to be in favor of the "sinking fund" plan. The subject is discusssed by the Wisconsin Railroad Commission in the Milwaukee Electric case with this conclusion:—

"In our opinion a most equitable situation arises where depreciation is calculated and provided on a "sinking fund" basis. The fund should be in the custody of a commissioner or trustee, to be invested by him, subject to call for money with which to make replacements when necessary."

Treatment of Amount Collected for Depreciation

On this subject the Wisconsin Commission in the same decision says:—

"The amount collected for depreciation can be treated in one of several ways. It can be loaned subject to call on very moderate rates of interest, being treated as a special trust fund represented by quick assets. It can be used from time to time to, temporarily at least, finance extensions and improvements. A considerable part of it, however, should at all times be immediately available for the purpose for which it is raised. However treated, it will be drawing some interest whether loaned or temporarily invested in extensions and improvements. Were it to be permanently invested in such extensions and improvements it would theoretically be earning interest at the same rate as the other original investment. As a matter of practice, however, this probably does not happen. As a rule, some time elapses after the expenditure before much additional return is earned on the new property. The fund is subject to be called upon at any time for the use for which it has been laid aside, and such extensions and improvements in a growing concern, at least, are usually financed, before the lapse of any extended period, by the issue of new securities."

In addition to these suggestions it would seem that in the case of a company which is strong financially, the trustee could lend the funds in his hands to the company on its note or notes, at the low rate of interest at which the annual payments have been calculated, reserving a sufficient amount on hand, on deposit or loaned on call, to take care of such ordinary replacements as are likely to occur. If some unusual demand for replacement should be made, the trustee could demand payment by the company of a sufficient amount on its note or notes to meet the demand for cash from the replacement fund. This would seldom occur, and if it did, the company would, in the meanwhile have had the advantage of the use of funds at a low rate of interest instead of having to sell bonds or stock or borrow from bank at bank rates of interest. The time when new capital had to be procured would thus have been deferred.

Right to Return on Replacement Fund

There is one other fact in the consideration of this subject which we must grasp clearly and insist upon. That is that the investor has the right to a reasonable return not only upon the depreciated value of the plant, but upon the replacement fund; for this fund is what maintains his investment at its original amount or value. But, it will be argued: "The fund is earning interest and you are asking a double return on it." The answer to this argument is that because the fund earns interest the annual amount paid into the depreciation fund is less than it would be otherwise, and the interest that the fund earns becomes part of the fund and is not returned to the investor. Both the annual payment and the interest are necessary to create a fund sufficient to make replacements as they are required, assuming that the calculations on which the fund is based are correct. This would not be true if the fund were created on the "straight line" basis, as was pointed out by the Wisconsin Commission in the Milwaukee case. Assume that a plant has cost $100,000. There can be no question of the right of the investors in that plant to earn a reasonable return upon that amount the first year. Suppose that the depreciation amounts to $10,000 in the first year, and a replacement fund of that amount is set aside from earnings. Shall the reasonable return for the second year be based on an investment of $90,000 and this amount reduced year by year? If the balance sheet shows:—

ASSETS *Account number*			LIABILITIES	
100, 101	Fixed capital	$100,000		
102	Depreciation of structures and equipment reserve (red)	10,000		
	Depreciated plant value	90,000	Stock, Bonds	$100,000
113	Depreciation replacement funds	10,000		
		$100,000		

Then the answer is plain.

Since preparing the foregoing, the author's attention has been called to the decision of the Indiana Public Service Commission, Re: United Public Service Company of Rochester, Ind., P. U. R., 1918-F, page 316. In passing upon the matter of depreciation the commission comments as follows:—

"The commission is confronted with the fact that, after five years' operation of the law in Indiana, the intent of the depreciation provisions has not been realized. The practice, both in this state and elsewhere, is to dissipate these moneys.

"In estimating allowances to be made to cover depreciation, the Public Service Commission of Indiana adopts a rate allowance which presupposes that moneys provided to meet deferred depreciation shall not lie idle. Such moneys create the 'depreciation fund.' If this fund compounds itself, then the rate of allowance to cover depreciation may be made lower than otherwise. In other words, a fund so administered means a lower rate to the patrons or consumer than if such fund is not interest bearing. For the utility, the creating of such an actual depreciation fund constitutes an asset that should favorably influence its credit. In times of stress or disaster a utility having such a fund may be able to either borrow from this fund or convert or pledge securities held in such fund, and thus be relieved of heavy discounts otherwise incurred.

"Sound and desirable as is the theory, the practice in this and other states is almost universally different. Depreciation moneys are paid out in dividends or used in other ways. The result is that in many cases the 'depreciation fund' is a meaningless bookkeeping account. There is no reserve fund, though the patrons have provided money for such a fund. The public utility is, instead of being financially fortified, reduced to the practice of merely charging off annually on its books a certain amount of the value of its property, reducing rather than maintaining its property value. Often this is finally reflected in poor service. The consumer who has provided proper funds is penalized in service because of improper administration.

"The appended order provides that this utility shall take out of its revenues—the same as it will take moneys for operation, taxes, interest, and dividends—the money allowed and collected under the law, for depreciation; that it will pay such moneys into a depreciation fund; that such funds shall be held intact and separate at all times; that there shall be paid out of such funds all cost—including labor as well as materials—of replacing depreciation; that the funds shall be administered with proper accounting; that interest on such depreciation funds shall accrue not to the utility, but to the fund; that petitioner itself may, with limitations, borrow from the fund, but in such event shall place in said fund its own obligations, in the form of notes or bonds bearing interest payable to the fund.

"The order does not contemplate that, when depreciation funds are borrowed by the utility itself, there shall be a mere bookkeeping account. In other words, the moneys derived from allowances to cover depreciation that are made in rates are to be regarded as a trust fund provided, as prescribed by law, by those served for the benefit of the utility, but not in reality belonging to it until such moneys are translated into actual plant replacements; and such fund must be handled, at the utility's risk, to the best advantage of the consumers and patrons and stockholders and bondholders."

UNIT PRICE CONTRACTS vs. PERCENTAGE CONTRACTS*

By W. L. Darling

IN construction, one or more of three different methods are employed:—

First, company force;

Second, unit price or an agreed sum, with a provision for a percentage, to be increased or decreased as the cost of the work decreases or increases, compared with the agreed cost;

Third, a percentage based on the actual cost of the work.

In the present state of the art, I think it can be safely assumed that the first method should be used only when the work is too small to contract, or when the local or emergency conditions are such that it is not practical to contract, or when the owner has experts in a certain specialized line that are superior to those of the contractors.

The main question, therefore, is: Shall the second or third methods be used, and if the third, will it affect the art, and, consequently, the public?

Energy the Greatest Asset

To discuss it, it is necessary to examine the effort of the contractor himself. The great incentive is to make money, and it is this incentive that has created his value to the owner and to the public. The overcoming of obstacles, financial as well as physical, has produced energy and versatility that could have been acquired in no other way, and, to my mind, energy is his greatest asset. What use is it if he has all the intellect and physical qualities in existence if he has not the energy to use them?

He must have a knowledge of men and plant; where labor can be readily obtained and the plants available; he must know about his supplies, where they can be obtained and how best transported; he must know the market conditions and have an intimate knowledge of the work to be done.

If the work is done on unit price basis, the owner gets the results of the judgment and the experience of many men and many firms. One will see better where supplies are obtainable; another may have a better plant for the job; another may have a better method of doing the work, and it is the pitting of all these men, one against the other, that the owner gets the advantage of.

By the percentage method a man or firm is selected for managing the work; hence the owner gets the benefit of one man's knowledge, and the wrong man may have been selected. I have known men to make a bid on a piece of work by merely sizing it up, and knowing where the necessary outfits were and the men to whom it could be sublet. If he has made a bad guess, he simply has to find some way or means to back up his judgment. I believe some men become so familiar with work that their guess is as good, if not better, than some men's figuring. At any rate, the difficult tasks that they set for themselves bring out all the surplus energy that is in them, and this is what the owner gets the benefit of, and what he will not get should competitive methods be eliminated.

Turning Loss Into Gain

The contractor working on a unit price basis has not only a reputation, but also his very livelihood at stake. We have often seen a man take work at unit prices so low that a heavy loss seemed inevitable, but by using new methods, new tools and exerting surplus energy, he has been able to turn an almost certain loss into a profit for himself, and a much greater profit for the public, as these new methods can be used on further work and by other men.

Contractors, I believe, can materially improve the art of drawing closer lines between their business and the

*From an address delivered March 27th at an organization meeting of the Northwest Association of General Contractors, St. Paul, Minn.

owner's. Unit prices and specifications should be more definite. The question of custom between contractor and owner should be eliminated. The contractor should have better data on which to base his bid. There has been a growing custom not to pay as much attention to the contract as to customary settlements. I believe that much better results would be obtained if the contractors would insist on the contract and specifications being followed, and if conditions should arise when the intent of the contract would be materially affected by having a definite understanding as to price and conditions before going ahead.

Progress Dependent Upon Incentive

Under past conditions work has been suddenly authorized with no time given either the engineer or the contractor to determine costs or make intelligent bids. A much smaller margin between the estimate and the actual cost of work would result if these conditions could be known. The risk of the contractor would be much smaller, and the owner would have more definite knowledge of what his work would cost.

An agreed price, varying with the percentage, has many good points when the work is simple and conditions are such as to permit of it, but it could not be used very well on railroad work, for instance, unless the conditions were properly determined beforehand; and right here is where the owner or contractor can greatly improve present methods by determining unforeseen conditions.

By the percentage method the contractor has few financial troubles to overcome, no particular inducements except pride to introduce new methods or tools, no sleepless nights to figure out some new scheme for the next day, no surplus energy to exert in himself or employees. The employee, knowing that his superior is not in financial troubles, does not exert himself unnecessarily. The contractor does not, perhaps, try new methods or new tools, as he may think he has no right to risk a failure. On the other hand, the unit price men must take the risk, and bend all their energy to make it successful.

My point is this: That these necessities of the unit price men have produced a personal result that could not otherwise have been acquired, and that as soon as the incentive is eliminated, progress will slow down, if it does not actually retrograde.

There is no question but what there are men doing percentage work that are just as competent and perhaps just as energetic as the unit price men, but I claim that it is because of the state of the art and its personnel, and due to previous efforts of the unit price men.

The main objections to the unit price methods are that in instances contractors make too much money, and that the percentage method will eliminate that danger.

Frequently, a large profit is due to the fact that a contract was taken on a high market and the work done as the market fell. If the reverse condition obtained, there would have been a loss and no comment made.

Unit Prices Decreasing

It has seemed to me the best way to determine the amount of money made by contractors is to consider the work done here in the Northwest for the last forty years, and then to determine the wealth of the various men who have been engaged in that business during that time, and who have not made their money elsewhere. While it is true, perhaps, that in individual cases owners have to pay larger sums than by a percentage method, I do not think it is generally true.

It seems to me that the great results of the unit price method is the fact that during the last forty years, under normal conditions, unit prices have decreased in the face of rising values of labor and material, and have produced a class of men who, when the emergency came, were able to accomplish things that did not seem possible. If you give up the unit price or competitive methods, it is going to result in one of two things: You are going to have a lot of superintendents, or else you are going to have only a few great, big contractors. In pioneer work sometimes a lot of money has been made. I have seen that in offering work and asking for proposals a number would look it over and make their bids, but some fellow would know the conditions better than the other, and know how to save a lot of money and time by knowledge of those facts. However, he would go in and make a good big bid, and the owner would accept it, and the consequence be that he would make a lot of money.

There is, of course, the social side to consider. Will labor, as a rule, be better compensated or its welfare enhanced by either method? Personally, I do not think so, as welfare is a matter for legislation, and compensation must be determined either by the market or by legislation.

There is a growing disposition all over the country to eliminate competition, but it seems to me that the better results will be obtained only where competition produces waste, but not where it is a creator of new methods, inventions and energy.

FINANCING OF HIGHWAY IMPROVEMENTS*

Maintenance from Motor Fees—Direct Appropriations and Special Assessments—Bond Issues Becoming Popular

By J. E. Pennybacker
Secretary of The Asphalt Association; Formerly of the U. S. Bureau of Public Roads

THERE are eight distinct sources of road revenues. These are: (1) Personal taxes paid in labor and by an arbitrary annual fee, known as a poll tax; (2) direct property taxes; (3) proceeds of registration and license fees on motor vehicles; (4) direct appropriations from general treasuries; (5) special assessments on property in road improvement districts and against property abutting and contiguous to a designated road; (6) sale of bonds; (7) appropriation by the National government; (8) collection of tolls, and (9) miscellaneous sources, such as sales of lands, profits from state industries, taxes on corporations, sale of permits, etc.

It may appear from the foregoing that the public road reaches all of the possible sources of taxation, and, theoretically, this is true, but, practically, the general trend of road finance is toward a reliance upon direct property taxes, motor vehicles revenues, sale of bonds and Federal appropriations. The other sources are incidental and quite local in their application.

Statute Labor Sometimes Suitable

The labor tax has been ridiculed and condemned at every good roads meeting during the past decade. It is unquestionably an inefficient and wasteful method, both of paying taxes and building and repairing the road, but it is probably the lesser of evils in localities where a large proportion of the population holds little or no property, is thoroughly accustomed to manual labor as tenants of farms and plantations, and can only be reached effectively for the performance of civic duties through the imposition of a tax upon their manual rather than financial capacity. I should consider, therefore, that it might be desirable to consider the retention of some form of statute labor tax where the local conditions are such as I have described.

The direct property tax for road purposes probably will always be necessary, both as a source of revenue and as a means of reaching all beneficiaries of road improvement, but many reforms and improvements are necessary before this method of finance can be held to really serve its purpose equitably. It is well known that the ratio of taxable to actual value varies not only among the states and provinces in a wide degree, but in many of the states there is a wide variation among the several counties. Manifestly, if a state or provincial tax be levied for road purposes and

*Address before State Highway Officials.

the property in one county is assessed at 40 per cent. of its actual value, while the property in another county is assessed at 60 per cent. of its actual value, there is immediately an unjust discrimination against the latter county. The practice of equalizing assessments by boards of equalization should be vigorously urged in connection with the levying of taxes for road purposes.

Adjusting Direct Taxation Equitably

In some of the states, cities are not taxed for county purposes, and, consequently, heavy automobile traffic from cities exerts a destructive influence upon country highways without any corresponding return in the form of taxes. The remedy is either to make the cities taxable by counties for road purposes or to include practically all of the heavily-travelled highways in the state or provincial system and reach the cities by the direct state tax. It would seem to be fundamentally necessary that roads be classified and segregated into distinct systems as a condition precedent to the establishment of direct property taxes. Probably some budget plan could be worked out in which the requirements of the state, county and township highway systems respectively could be ascertained, and the total tax rate then adjusted so as to yield amounts proportionate to such findings. The net outcome would be that the man who lived on a state road would pay the heaviest tax, the man who lived on the county road the next heaviest, and the man who lived on the township road the lightest tax, but each, instead of paying three distinct taxes, would pay one.

For the reason that it is easier to convince the public of the necessity of building a good road than it is to convince them of the necessity of keeping it up, I would advocate dependence upon the direct property tax as far as possible for the construction of state or provincial roads and for meeting interest and retirement requirements on state bond issues, thus leaving to motor vehicle fees the burden of first supporting state highway organizations and maintaining the roads, and applying only the surplus from such revenues to the construction of roads and the payments of principal and interest of bonds. For county and township roads it will continue to be desirable and necessary to levy the direct property tax for practically all highway purposes, less such amounts as may be granted by the Federal government and the states or provinces as aid.

Motor Fees for Maintenance

Proceeds of motor vehicle registrations and licenses have increased enormously during the past few years.

As suggested in the preceding paragraph, this revenue should first be applied to the support of state highway departments and to the maintenance of state highways for the reason that the revenues are regularly available without the irritation to the taxpayer which comes from levying a direct tax each year. In other words, having secured a good road, the average taxpayer is apt to consider the road as a permanent institution, and to resent the necessity of continuing to tax himself to keep it up, whereas, he is not so likely to oppose spending the generous motor vehicle revenues for this purpose. I believe, therefore, that it is a mistaken zeal which seeks to tie up motor vehicle revenues for the payment of interest and retirement of bond issues, thus leaving to the tender mercies of the taxpayer the roads built at great expense and for which debt has been incurred.

Questions as to the basis of levying the fees on motor vehicles are interwoven in a very intricate manner with questions of regulation looking to the protection of the highway, so that the matter is not purely one of revenue. Thus far the tendency seems to be quite general to base the tax on the ordinary motor vehicle on horse-power at rates now generally regarded as equitable at anywhere between 40 cents and $1 per horse-power. Motor trucks, on the other hand, are more generally taxed on a weight basis. It would seem that there has been too much of a tendency on the part of each state to follow precedent. There ought to be good possibilities for the working out of an efficient and equitable basis of motor vehicle taxation through joint action of the best-informed men in those state highway departments which have had most intimate contact with this problem. The findings of such a committee would be exceptionally helpful to all of the states.

Appropriations and Special Assessments

Direct appropriations from general revenues are practicable in large and wealthy states or provinces and municipalities, but in view of the urgent necessity of carrying on highway construction and maintenance according to a comprehensive system and over a period of years, the dependence upon annual appropriations is too precarious to permit dependence upon this plan except for special and temporary purposes.

Special assessments in road improvement districts is a method of finance sometimes followed, and practically means the formation of a corporation of landowners who voluntarily bring upon themselves taxation for the purpose of improving their property by means of better highways. This method has proven successful in obtaining improved roads which could probably not be obtained through dependence upon popular vote. It localizes the burden, however, and is not equitable unless the road is of purely local importance. Any road used by traffic outside of the improvement district should have a wider field of taxation.

Bond issues for highway improvement are becoming popular at a rate which is not altogether reassuring. Certain fundamental questions, such as the length of term of the bonds, their payment on a serial rather than a sinking fund basis, the rate of interest, the determination of the roads to be improved, the solving of the difficult problems of type and dimensions of roads, should be worked out ahead of the sale of bonds so that these vast outlays may not produce such niggardly results as to cause a reaction.

Toll System Has Application

The collection of tolls, while generally tabooed by intelligent public sentiment, may yet assume a position of real importance in the financing of road work. In the old days objection was made to tolls because they were usually collected by private companies on public rights-of-way, because the cost of collection was out of all proportion to the amount of revenue derived, and because it was impossible to prevent gross dishonesty. It is possible to meet these faults by having the toll collected by the state or province and not by private companies. Traffic has become so enormous as compared with the old days, and automatic devices for collecting and recording collections have been so highly developed as to make it possible to collect tolls at the cost of a small percentage of the total collections. The destruction to the roads of one tax jurisdiction by traffic coming from other tax jurisdictions naturally directs attention to the toll system as one means of meeting this condition. The toll system is distasteful and inconvenient to the road user, and may be made unduly expensive, but on the general theory that payment should be made for service rendered, it would hardly seem that the road user could legitimately object to paying for the benefit of using a good road. I am not prepared to advocate the toll system, but I consider that it should not be dismissed lightly as a relic of the barbarous ages.

Restriction of Federal Aid

Finally, the aid granted by the Federal government has become of considerable magnitude. At present it is left to the state highway departments in the first instance to determine where the Federal aid is to be expended. It would certainly seem that the national government should concern itself with those roads which are of national importance, and, in line with this conclusion, the granting of Federal aid should be restricted to a national system, or at least to those roads which are interstate in character. If this be done, it will be one more step in the logical development of the principle of apportioning burdens to each unit of government according to the benefits derived.

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WORLD'S MOST POWERFUL PRIME MOVER

WHEN reading the heading, "The World's Most Powerful Prime Mover," which appears upon another page of this issue, the reader must bear in mind that the unit described is of the cross-compound type, and not a single generator and single turbine.

From an operating standpoint, however, this type of unit is as much a single unit as if but one generator were employed. All the steam passes through a single high pressure cylinder and the entire unit is controlled by one main throttle. The generators are started up and operated electrically as a single unit. Regardless of these facts, however, it is questioned by many engineers whether it is entirely proper to refer to a unit of this character as a "unit" unless the term be distinctly qualified in every case by the word "compound."

As a single unit, of course, no one of the three generators in the Interborough's 60,000 k.w. compound unit would compare in output with any one of a considerable number of other generators that have been built: For example, the 50,000 k.v.a., 187 r.p.m., vertical, water-turbine-driven generators that are being built by the Westinghouse Co. for the Hydro-Electric Power Commission's proposed Queenston plant; the 50,000 k.v.a., steam-turbine-driven unit which was installed about a year ago by the General Electric Co. in the plant of the Detroit Edison Co.; the 40,000 k.v.a. generator now under construction by the Westinghouse Co. for a United States Navy battle cruiser, to be steam-turbine-driven at 1,500 r.p.m.; the 38,889 k.v.a., steam-turbine-driven generator installed by the General Electric Co. in the plant of the Buffalo General Electric Co.; the 35,000 k.v.a., steam-turbine-driven generator operated by the Commonwealth Edison Co., of Chicago; or the 32,500 k.w., water-turbine-driven generator (at 80% power factor) which has been built by the General Electric Co. for the Cliff Electrical Distributing Co., of Niagara Falls, N.Y., but which has not yet been installed.

Although the generators which are in the Interborough Rapid Transit Co.'s plant are not of extraordinary size compared to those above mentioned, these cross-compound units are remarkable in their output, and from an operating standpoint can really be called "units," so that the title of "World's Most Powerful Prime Mover" is no doubt fully justified.

Among the other large cross-compound units that have been installed recently or are now under construction, is a 60,000 k.v.a. unit, with three cylinders and three generators, for the United States Navy's nitrate plant at Muscele Shoals, Ala.; also a 47,000 k.v.a. unit, with two cylinders and two generators, for the Duquesne Light Co., of Pittsburgh, Pa. A unit similar to the Duquesne one has been built for the Narragansett Electric Light Co., of Providence, R.I., and one similar to the Muscele Shoals unit is now under construction for the Duquesne Light Co.

LAYING WATER MAINS IN ALLEYS

ALTHOUGH the plan of laying water, gas and steam mains, sewers, telephone conduits and other public services in alleys instead of in streets, has been frequently advocated and sometimes tried, Chas. R. Henderson, manager of the Davenport Water Co., of Davenport, Iowa, writing editorially in the journal of the American Water Works Association, contends that for reasons applying to safety and economy, water mains had best be laid in the streets, although he is willing to concede that the alleys can be utilized for some utilities.

The principal objection to the alleys in cities is that they are not wide enough to accommodate all of the underground work, and, as usually laid out, are not continuous, nor do they run in both directions.

A few years ago Mr. Henderson tried to lay a small water main in an alley because it was desirable to avoid cutting a new pavement. In this alley there were several conduits, used by telephone, telegraph and power companies, and at the entrance of the alley were three manholes of considerable size. The pipe could not be laid between the manholes because they overlapped; it could not be laid through them because the companies owning them objected; it could not be laid under them because the ground was solid rock and blasting would disturb the conduit system. As a result, the new pavement was cut and the pipe was laid in the street.

In an Iowa city the principal main in the commercial district was laid in alleys. Fire hydrants at street intersections are supplied by long branches of smaller pipe. These long hydrant branches add to the loss of head between the main and the hydrant, and, as there is no flow in the pipe between the main and the hydrant, the danger of freezing is greater than in a normal installation.

Shut-off cocks and curb boxes for outside control are best located on sidewalks, says Mr. Henderson, if they are to be accessible when needed. They should always be located on public property. When in alleys, heavy vehicles are likely to pass over and break them. Moreover, it is desirable to place curb boxes in such positions that they will not be covered by ash barrels, manure heaps or any other hindrances to their accessibility.

Mr. Henderson tried the laying of water mains in alleys in a new residential suburb at Davenport, with unfortunate results. The growth of the suburb necessitated the construction of mains in some streets, so now he has some parallel mains one-half block apart.

For the above-mentioned reasons, and on account of the difficulty of providing sufficient hydrants for proper fire protection when mains are in alleys, Mr. Henderson is firmly in favor of keeping all water mains in the streets, regardless of the effect upon pavement construction.

CANADA'S DEPENDENCE ON ELECTRIC POWER

Many Resources Can be Developed Only Through Use of Hydro-Electric Energy

FEW realize the important relation which Canada's wealth in water power bears towards reaping the full benefit from her numerous other natural resources. It is true that these other resources would not otherwise be entirely lost to the country, but they would have to be exported as raw material in its most primary state with a minimum return to us. The presence of cheap power, which is almost invariably found side by side with these other resources, facilitates their development, while their full industrial value is retained in being able to deliver them as a fully manufactured product.

It may be even permitted to predict that this cheap power will soon attract raw material from other countries. For instance, the large aluminium plant on the United States side of Niagara Falls is operating largely from hydro-electric energy exported from Canada. Had it been physically or economically impossible to export this energy, as the question of power is of utmost importance, these works would have doubtless been attracted to use it on the Canadian side.

In Canada, the pulp and paper industry has been greatly expanded through the proximity of abundant water power to our forest resources. A recent census bulletin on this industry shows that there is a total of 524,252 h.p. installed to operate pulp and paper mills in Canada. From other figures given it is fair to estimate that at least 475,000 h.p. of this is derived directly or indirectly from water power.

If we consider pulp mills alone, the figures from the bulletin also demonstrate the important part which power holds in connection with this industry. The Canadian mills producing pulp exclusively are stated to have a yearly output of 490,615 tons, for which it is necessary to use 95,463 h.p. In other words, one horse-power will produce approximately five tons of pulp yearly. This one horse-power usually costs from $8 to $10 with water power, while, if other sources of energy had to be used, the corresponding cost might be from $30 to $50. This would mean an increase in cost of at least $4 per ton, or, in all probability, if the water power had not been available, the pulp would not have been manufactured.—From "Conservation."

COMPULSORY TOWN PLANNING

TOWN planning in Great Britain has so far advanced beyond the experimental stage that it has now been decided to make it compulsory for every town. having 20,000 inhabitants or more, to submit a town planning scheme for its own area to the Local Government Board, not later than 1926. Such a scheme must embrace the limitation of population densities per acre, define the portion of a site area to be covered with buildings, the character of the buildings, the lines of arterial roads and the provision of open spaces.

The British people realize that haphazard growth of towns leads to serious evils and they are determined to control it. In future, land will have to be developed so as best to serve the interests of the community, which, in the long run, is usually in the interests of the landholders themselves. Only the land speculator is adversely affected. If the public wish to put that individual out of business, they cannot do it more effectively than by actively promoting proper schemes of town planning.

In Canada, the province of Nova Scotia took the lead in making town planning compulsory in 1915. The only other province which has a compulsory Act is Saskatchewan. These are therefore the only two provinces abreast of the Old Country in town-planning progress, though most of our provinces have enabling Acts in force.—From "Conservation," published by the Commission of Conservation, Ottawa.

PERSONALS

JOHN LEY RETALLACK, of Vancouver, B. C., who was recently appointed as the first public utilities commissioner for the Province of British Columbia, has had experience in railway construction, banking, mining and corporation accounting. He served for five years with the Royal Northwest Mounted Police, and after his discharge in 1889, settled in the Kootenay district of British Columbia. At the outbreak of war he obtained a commission and soon became a major. He was at Ypres and the Somme and subsequently was connected with railway construction work at the Front. R. H. Gale, mayor of Vancouver, was first appointed to the position by the provincial government, but the Great War Veterans' Association protested against the appointment, urging that Major Retallack should receive the post on account of his war services and because of his technical qualifications. On account of this protest, Mayor Gale resigned two or three days after he had been appointed, and the provincial government then named Major Retallack. He is now examining into the scope and methods of public utility commissions elsewhere. His headquarters will be at Vancouver.

ALFRED G. KING, JR., formerly of the firm of King, Evans & Pickard, of Victoria, B.C., has been appointed city engineer of Nanaimo, B.C.

A. R. ROBERTS, formerly of Burns & Roberts, Ltd., has opened an office at 201 Bank of Hamilton Bldg., Toronto, and will deal in new and used machinery, contractors', railway and power plant equipment.

T. CARMICHAEL, who was assistant superintendent of the Public Works Department, Regina, Sask., is now directing the department in place of W. T. Mollard, formerly superintendent, who recently resigned.

L. P. BURNS, president of Burns & Roberts, Ltd., Toronto, has bought the interest in the firm held by A. R. Roberts, and will continue the business as formerly, the organization otherwise remaining unchanged.

MAJOR A. G. NUTTER, who prior to going overseas was connected with Mussens Limited, has associated himself with the exporting and importing firm of Wonham, Bates & Goode, Inc., New York and London. This firm has just opened an office at 145 St. James St., Montreal, under the management of Major Nutter.

GEORGE A. JOHNSON, whose partnership with Major W. L. Benham was announced in this column a short time ago, was promoted July 3rd to the rank of colonel. Colonel Johnson entered the service in the spring of 1918, as major, and was promoted to lieutenant-colonel on November 7th, 1918. He is now second in command of the operation and repair branch of the construction division of the U.S. Army, in charge of the operation and maintenance of road, railroad, building, water supply, sewerage, electrical and all other utilities in the various establishments under the jurisdiction of the United States War Department.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand or proposed, contracts awarded, changes in staffs, etc.

ADDITIONAL TENDERS PENDING

Not Including Those Reported in This Issue

Further information may be had from the issues of *The Canadian Engineer*, to which reference is made.

PLACE OF WORK	TENDERS CLOSE	ISSUE OF	PAGE
Annapolis Royal, N.S., bridge	July 14.	July 3.	118
Aurora, Ont., pumps	July 11.	June 26.	48
Comox, B.C., wharf	July 15.	June 26.	46
Connaught Station, Ont., wharf	July 15.	July 3.	50
Elora, Ont., bridge	July 11.	July 3.	118
Galt, Ont., fifty houses	July 15.	July 3.	48
Harriston, Ont., drain	July 14.	July 3.	46
Montreal, Que., coal crusher	July 23.	June 19.	50
Montreal, Que., coal drying equipment	July 23.	June 26.	52
Newmarket, Ont., bridge	July 11.	July 3.	46
North Bay, Ont., pavements	July 18.	July 3.	118
Ottawa, Ont., highway	July 18.	July 3.	118
Owen Sound, Ont., pavements	July 18.	July 3.	118
Pickering, Ont., highway	July 21.	July 3.	52
Prince Rupert, B.C., lighthouse	July 17.	June 26.	46
St. John, N.B., trenching	July 17.	July 3.	46
Thessalon, Ont., wharf	July 11.	June 26.	46
Three Rivers, Que., sidewalks	July 15.	July 3.	45
Toronto, Ont., bridge	July 21.	June 26.	48
Toronto, Ont., store	July 14.	July 3.	50
Toronto, Ont., fire escapes	July 15.	July 3.	50
Wawanesa, Man., bridge	July 11	July 3.	45
York Township, Ont., water mains	July 19.	June 26.	52

BRIDGES, ROADS AND STREETS

Arnprior, Ont.—The following contracts have been awarded by the county council: Berlanquet's bridge, on Road No. 15, Admaston and pipe culvert on that road by day labor; Jamieson's culvert over creek at $195.75 and culvert over Streasman's Creek for $4,748.50 to Grant Bros.; arch culvert over Hennessy's Creek to J. M. Kennedy at $7,865.75; concrete abutments on Road No. 5 at Beachburg to F. E. Fortin at $10,850.

Arnprior, Ont.—Three machinery units have been purchased by the county council. Roadwork will commence simultaneously at Pembroke, Renfrew and Arnprior. Cost of machinery, $5,614.83. Estimated cost of roadwork, $12,036.38.

Aurora, Ont.—Tenders will be received until noon, July 18th, for a bituminous bound macadam on concrete base pavement. (Official advertisement in this issue.)

Bancroft, Ont.—Hastings county council has authorized $30,000 to be spent on the provincial county highway, from Madoc to Tudor boundary north, and $25,000 from the boundary south. The county assumed as a county road a piece of highway about a mile in length running through Deloro.

Belleville, Ont.—Sidewalks will be constructed by the city council at a cost of about $16,635.06. J. W. Holmes, clerk.

Belleville, Ont.—The city council plans to construct pavements on several streets. Estimated cost, $17,756.50. J. W. Holmes, clerk.

Bowness, Alta.—The Bowness motor road will be repaired this summer. Commissioner Graves.

Bridgeburg, Ont.—The town council is planning an expenditure of $10,000 for roadway improvements. Part of this will be spent on Jarvis St., which will be graded, and a considerable portion on the extension of the sewerage system through a certain portion of Amigari. Grading will also be done on Central Ave. Reeve Atwood.

Chatham, Ont.—The city council contemplates the purchase of an asphalt paving plant at about $20,000, to be used this summer in repairing streets.

Chatham, Ont.—Contract for pavements on Amelia St. has been given to George Field, Chatham.

Elderslie Township, Ont.—F. B. James, county engineer, has awarded contract for 60-foot steel truss bridge and concrete abutments to the Hunter Bridge and Boiler Co., Ltd., Kincardine, Ont. Tender price, $4,280.

Fredericton, N.B.—The county council contemplates repairs to highway leading to the Magaguadavic Lake.

Gananoque, Ont.—Work in the construction of the eastern section of the provincial highway will be started this week. Mr. Baldwin, Toronto, is the engineer and will have charge of the district between Kingston and Brockville.

Iroquois Falls, Ont.—$20,600 will be expended this year by the town council for construction of concrete curbs. A. J. Hodgson, clerk.

Iroquois Falls, Ont.—Tarvia macadam pavements will be constructed by the town council on several streets. Estimated cost, $35,640. A. J. Hodgson, clerk.

Iroquois Falls, Ont.—The town council plans to construct sidewalks at a cost of $6,000. A. J. Hodgson, clerk.

Iroquois Falls, Ont.—The town council will expend $7,200 this year for grading blocks "A" and "B," and for constructing triangular parking spaces at various street intersections. A. J. Hodgson, clerk.

Kindersley, Sask.—Tenders will be received until noon, July 21st, by H. A. Dixon, chief engineer, Can. Nat. Rys., Winnipeg, Man., for the construction of five reinforced concrete culverts, mile 77 to mile 89, Kindersley subdivision. Plans, specifications, instructions to bidders and form of tender can be obtained at the offices of the chief engineer, Winnipeg; district engineer, Saskatoon; freight agent, Regina; district engineer, Edmonton, and superintendent, Calgary.

Kingston, Ont.—Tenders will be received until noon, July 21st, by Duncan C. Scott, deputy superintendent-general of Indian affairs, Ottawa, for bridge work, Caradoc Indian Reserve, Ont. Plans and specifications may be seen at the office of the Indian agent at Muncey, postoffices at London and at St. Thomas, and also at the department of works, Ottawa.

Kitchener, Ont.—Tenders will be received until July 10th, by D. H. Fleming, engineer, for construction of pavements.

L'Assomption, Que.—Tenders will be received until 7.30 p.m., July 18th, by Jos. E. Duhamel, secretary-treasurer, L'Assomption, Que., for construction of bridge between the municipalities of the parish of Repentigny and the village of Charlemagne. Plans and specifications may be seen at the department of public works.

Montreal, Que.—Laplaine and Brisebois, Montreal, have been awarded the contract by the Marcil Trust Co., for six miles of road at Strathmore, Que., four miles at Lakeside, five miles at Dorval and one mile at Dixie, Lachine.

Ontario County, Ont.—The amounts to be raised by the county council for good roads are: Pickering township, $4,678; Whitby township, $2,023; E. Whitby township, $1,855; Reach township, $2,581; Scugog, $374; Uxbridge township $1,382; Scott township, $1,599; Thorah township, $1,299; Brock township, $3,169; Mara township, $1,926; Rama township, $436; the town of Whitby, $1,410; Oshawa, $4,144; Uxbridge, $572; Port Perry, $570; Cannington, $321; Beaverton, $375.

Ottawa, Ont.—The Dominion highways bill has been passed by the House of Commons, appropriating $20,000,000 for the construction and improvement of roads throughout Canada.

Ottawa, Ont.—Votes of parliament for roads and bridges include $25,000 for an international bridge across the St. John River at Edmundston, N.B., and $100,000 for a new bridge at Burlington Channel, Hamilton.

Pefferlaw, Ont.—The Sherwood Construction Co., Ltd., Harbor Commission Building, Toronto, has been awarded the contract for concrete culverts and bridge abutments between mileages 56, Pefferlaw, and 94, Sparrow Lake, in the Muskoka subdivision, by the Can. Nat. Rys.

Peterborough, Ont.—At a recent session of the county council a by-law was passed authorizing the townships of Otonabee and North Monaghan to enter upon the good roads policy. The council also decided to expend $14,000 on new bridges throughout the county.

Peterborough, Ont.—Contract for pavements on Water St. has been awarded by the board of works to R. Sheehy, Peterborough. Contract prices: R. Sheehy, concrete pavement, $2.69 per sq. yd.; concrete curb, 39 cents per lin. ft.; concrete apron, 29 cents per sq. ft. John E. Hayes, concrete pavements, $2,79 per sq. yd.; concrete curb, 60 cents per lin. ft.; concrete apron, 29 cents per sq. ft. J. Bogue, Lindsay, concrete pavements, $2.75 per sq. yd.; concrete curb, 35 cents per lin. ft.; concrete apron, 40 cents per sq. ft. R. H. Parsons, concrete pavement, $2.70 per sq. yd.; concrete curb, 50 cents per lin. ft.; concrete apron, 28 cents per sq. ft. H. R. Martin, concrete pavement, $3.20 per sq, yd.; concrete curb, 60 cents per lin. foot; concrete apron, 40 cents per sq. ft. T. H. Hickey, concrete pavement, $3.38 per sq. yd.; concrete curb, 82 cents per lin. ft.; concrete apron, 42 cents per sq. ft.

Regina, Sask.—Concrete sidewalks are contemplated by the city council on Rose St. Estimated cost, $1,327.92. Geo. Beach, city clerk.

Regina, Sask.—The city council will construct pavements on Dewdney St. at a cost of $24,494.80. Geo. Beach, city clerk.

St. John's, Que.—The city council will construct sidewalks at a cost of about $34,000. H. Bourassa, engineer.

St. Rose, Que.—Contract for macadam roads has been awarded by the municipal council to O'Connors, Ltd., 204 St. James St., Montreal.

Sudbury, Ont.—The Can. Nat. Rys. have awarded contract for culverts, abutments and piers on Sudbury subdivision to the Sherwood Construction Co., Harbor Commission Building, Toronto.

Thamesville, Ont.—A new bridge will be erected at Duffries Creek. County road superintendent Pardo.

Toronto, Ont.—Asphalt pavements will be constructed by the city council on Annette St., Chestnut Park Ave., Kenilworth Ave., and brick block pavements on Cypress St., and granite block pavements on Eastern Ave. Estimated cost, $178,870. W. A. Littlejohn, city clerk.

Toronto, Ont.—Contracts for asphalt pavements on Davenport Rd., Hastings Ave., Indian Grove, Orchard Park Boulevard and Seaforth Ave. have been awarded the commissioner of works at $26,692.

Toronto, Ont.—Grading of Gerrard St. will be carried out under the supervision of the commissioner of works at an estimated cost of $53,650.

Toronto, Ont.—New tracks and pavement will be constructed on King St. at a cost of $270,000.

Toronto, Ont.—Plans are in progress for construction of highway bridge at Cherry St. and retaining sea wall opposite exhibition grounds. Estimated cost, $289,520.

Toronto, Ont.—Reconstruction of track allowance pavement on Front St., between Bay St. and York St., will be carried out by day labor, the commissioner of works having submitted the lowest tender, $13,561. Other tender prices ranged from $19,686 to $19,855.

Toronto, Ont.—The board of works has awarded contract for asphalt pavements, previously authorized to be constructed by day labor, but now transferred from the commissioner of works to the following contractors: Pacific Ave., to the Constructing and Pacing Co., at $13,808.16; Geary Ave., to the Godson Contracting Co., at $10,277.12.

Toronto, Ont.—The city council contemplates construction of the following: 16,000 feet boulevard drive curb, 14,000 feet traffic road curb, 90,000 square feet concrete walk, 182,400 square feet board walk, 13,510 feet of storm water drainage. 75,000 square yards grading and sodding, 41,970 square yards concrete boulevard drive pavement. Total cost, $384,721.

Toronto, Ont.—The city council plans to construct cement concrete sidewalks on Erie Terrace and Kenilworth Ave., at a cost of about $14,591. W. A. Littlejohn, city clerk.

Toronto, Ont.—The cost of grading Benson Ave. will be about $1,084. W. A. Littlejohn, city clerk.

Toronto, Ont.—The following contracts have been awarded by the board of works for concrete sidewalks: Dorval Ave., by day labor, at $2.32 per lin. ft.; Fernwood Park Ave., to A. Johnson, at $1.09⅛ per lin. ft.; Glenmore Rd., to The Ramsay Contracting Co., at $1.73¾ per lin. ft.; Kennedy Ave., to The Ramsay Contracting Co., at $1.73¾ per lin. ft.; Miller St., by day labor, at $2.32 per lin. ft., being the only estimate submitted; Seaforth Ave., to The Ramsay Contracting Co., at $1.18¾ per lin. ft.; Walpole St., to A. Johnson, at $1.77½ per lin. ft.

Toronto, Ont.—The Godson Contracting Co. have the contract for brick block pavements on Indian Grove. Tender price, $4,149.

Toronto, Ont.—The harbor commissioners will, as part of the waterfront park system, construct bridges, a boulevard drive, walks and bridle-paths and other improvements. Estimated cost of work, $1,325,783.80.

Toronto, Ont.—The Warren Bituminous Paving Co., Toronto, have been awarded contracts for bitulithic pavements on Orchard Park Rd. and Prescott Ave. Tender prices, $4,506.95 and $13,447.70.

Victoria, B.C.—Concrete sidewalks will be constructed on Princes Ave. E. W. Bradley, municipal clerk, Victoria, B.C.

Walkerton, Ont.—Contracts for 60-ft. and 30-ft. reinforced beam-slab bridges on the Elderslie and Arran Line Rd. have been awarded to the Hunter Bridge and Boiler Co., Ltd., Kincardine, Ont. Contract amount, $5,500.

Walkerton, Ont.—Tenders are being called for four small reinforced concrete bridges in different parts of Bruce County. F. B. James, county engineer.

Wallace, Man.—Contract for four culverts in the municipality of Wallace has been awarded to Geo. Harris, Virden. Tender price, $1,280.40.

Welland, Ont.—Tenders will be received until noon, July 21st, by Robert Cooper, county clerk, Welland, for either water-bound macadam or bituminous penetration paving, or broken stone foundations in the township of Humberstone and Wamfleet. Also for one mile of concrete pavement or tar penetration surface on Ridge Rd., Ridgway.

Westfield, N.B.—The department of public works has awarded the contract for the steel superstructure of the Nerepis Mouth highway bridge to the Maritime Bridge Co., New Glasgow, N.S. Estimated price, $20,000.

Whitby, Ont.—Tenders will be received until July 21st by Hon. W. A. MacLean, department of highways, Toronto, for erection of bridge.

Windsor, Ont.—City engineer Brian has estimated the cost of memorial subway under the Detroit River at about $6,000,000.

Winnipeg, Man.—The city council plans to construct asphalt pavements on Ellice Ave., Vaughan St., Magnus Ave., Lipton St., Lilac St. and Redwood Ave. Estimated cost, $87,853. C. J. Brown, city clerk.

Winnipeg, Man.—Granolithic sidewalks will be constructed by the city council on Ruskin Row, Bryce St., Corydon Ave., Derby St., Magnus Ave. and Martha St., at an estimated cost of $9,686. C. J. Brown, city clerk.

York Township, Ont.—Contracts for sidewalks have been awarded as follows: To Frank Angatto, Henrietta St., $2,100; Rogers Rd., $1,600; Holborne St., $528; Humewood Dr., $625; Glenholme Ave., $875; Westmount and Miller Sts., $1,577. To National Contracting Co., Northcliffe and Miller, $2,768; Wellwood St., $1,080. To Grant Contracting Co., Conway St., $625; Mould St., $1,275. Rejected tenders: From National Contracting Co, Henrietta St., $2,458; Rogers Rd., $1,828; Humewood Dr., $738; Westmount and Miller, $1,788; Mould St., $1,388. From Frank Angatto, Northcliffe and Miller, $2,870; Conway St., $660; Mould St., $1,275; Wellwood Ave., $1,188. From Grant Contracting Co., for Henrietta St., $2,200; Rogers Rd., $2,060; Glenholme Ave., $1,009; Westmount and Miller, $1,980; Northcliffe and Miller, $3,190; Wellwood St., $1,245. From Johnson, for Holborne St., $600. Tenders for McRoberts St., from Frank Angatto, $3,500; from Grant Contracting Co., $4,410; and from Johnson, $4,800, have been laid over for further consideration. Frank Barber, county engineer.

PARLIAMENT BUILDING, OTTAWA

TENDERS WANTED FOR
"GRANITE STEPS, CURBS, FLAGGING," ETC.

Sealed tenders will be received by the undersigned until **noon, July 21st, 1919,** for the "Granite Steps, Curbs, Flagging," etc., required in the construction of the above building.

All tenders to be based on the manufacture, supply and delivery at the building of the "Granite Steps, Curbs, Flagging," etc., shown and described by the plans and specifications.

The work of this contract shall be proceeded with immediately upon the signing of the same, and continued as may be directed and in such a manner as to ensure completion of the whole work by **October 31st, 1919.**

Plans, specifications and any other information required can be obtained at the office of the General Contractors, **P. Lyall & Sons Construction Company, Limited, Ottawa.**

Each tender must be accompanied by an accepted cheque on a chartered bank, payable to the order of the Minister of Public Works, for a sum not less than five per cent. (5%) of the amount of the tender, which will be forfeited if the parties tendering decline to enter into a contract when called upon to do so. If the tender is not accepted, the cheque will be returned. If the tender is accepted an additional cheque for a sum equivalent to five per cent. (5%) of the tender must be deposited before the contract is signed. The total security will be forfeited if the contractor fails to complete the work contracted for.

Payment for material will be made monthly.

The lowest or any tender not necessarily accepted.

Envelopes containing tenders to be marked, "Tender for Granite Steps, Curbs, Flagging, Etc.", and addressed to the undersigned.

JOHN A. PEARSON, Architect.
J. O. MARCHAND, Associate.
Centre Block, Parliament Hill,
Ottawa. 292

WATER, SEWAGE AND REFUSE

Acton, Ont.—James, Loudon and Hertzberg, Toronto, are the engineers for sewerage system for the town council.

Amherstburg, Ont.—Tenders will be received by W. A. McCormick, town clerk, Amherstburg, until 8 p.m., July 14th, for constructing the King St. sewer.

Aurora, Ont.—Tenders will be received until July 18th by C. A. Petch, clerk, for storm sewers. (Official advertisement in this issue.)

Belleville, Ont.—Sewers will be constructed by the city council at a cost of $32,871.06. J. W. Holmes, clerk.

Belleville, Ont.—Tenders will be received until 5 p.m., July 18th, for the construction of sanitary sewers on Cedar St., Yeomans St., Isabel St. and Boswell St. Plans, specifications and form of tender to be seen at the office of the city engineer. J. W. Holmes, city clerk.

Greenfield, Ont.—Contract for Morrison drain has been awarded to H. J. MacCrimmon, Williamstown, Ont., at the following prices per cu. yd.: Earth excavation, 32 cents; Rock excavation, $2; Hard-pan excavation, $1.10; reinforced concrete, $20; earth grading, 75 cents; gravel grading, $2.

Guelph, Ont.—The Goldie and McCullock Co., Ltd., Galt, have been awarded contract by the city council for installation of 750-gallon pump with a 75 h.p. Crocker-Wheeler motor, at $2,904, and for 1,250-gallon pump with 125 h.p. Crocker-Wheeler motor for $3,640, at the water works pumping station. The Bawden Pump Co. has been given the contract for a booster 2,100-gallon pump with a 100 h.p. Crocker-Wheeler motor at $2.621.

Iroquois Falls, Ont.—Tile sewers will be constructed by the town council on various streets. Estimated cost, $9,000. A. J. Hodgson, clerk.

Milton, Ont.—Construction of water system is contemplated by the town council.

Moncton, N.B.—Contract for trunk sewer has been awarded by the city council to James E. Kane, St. John, N.B. Tender price, $18,391.

Montreal, Que.—Tenders will be received until noon, July 15th, for the construction of brick sewers on Plamondon St. and Decarie Boulevard. Forms of tenders, copies of specifications, and all required information may be obtained at the office of the sewers department, city hall. Rene Bauset, city clerk.

Oshawa, Ont.—The town council contemplates construction of sewers and water mains. Mayor, J. Stacey.

Port Colborne, Ont.—Construction of water mains is planned by the town council at a cost of about $95,000.

Regina, Sask.—The city council will construct domestic sewers on Cameron St., Garnet St., McTavish St. and Argyle St. at a cost of $1,749.02. Geo. Beach, city clerk.

Regina, Sask.—Water main extensions will be erected on various streets at a cost of about $12,003.60. Geo. Beach, city clerk.

St Catharines, Ont.—Contracts for three sewerage systems have been awarded by the city council as follows: Facer St system to McLaughlin Bros., Ottawa, at $31,939.86; Western Hill system to Mitchell and Mohan, London, at $43,335; Eastern District to Mitchell and Mohan, London, at $5,200.

Toronto, Ont.—Contract for sewer outlet on Kippendavie Ave. at the lake front has been awarded the commissioner of works at $44.70 per lineal foot. This was the only estimate submitted.

Toronto, Ont.—Construction of sewers on Gladstone Ave. and Dovercourt Rd. will be carried out under the commissioner of works. Prices: Gladstone Ave., 3 ft. by 3 ft. brick section at $14.50 per lin. ft. and 18-in. tile section at $9.20 per lin. ft., Dovercourt Rd., at $14 per lin. ft.

Barrett Specification Roof on the Geo. Pattinson Co. buildings, Preston, Ont. General Contractors—P. H. Secord & Sons, Brantford, Ont. Roofer—Brown Jarvis Roofing Co., Brantford, Ont. Architect—J. Micklen, Preston, Ont.

These Buildings all have Roofs that can be *forgotten* for 20 Years!

THE owner of each of these buildings has received from us a Surety Bond, issued by one of the largest surety companies in the world, *guaranteeing their roofs against leaks, wear, and maintenance cost for twenty years.*

Of course, Barrett Specification Roofs do not need this guaranty to make them wear and last. The fact that most of the important buildings in Canada have the Barrett Specification type of roof proves that.

Barrett Specification Roof on the plant of the Pollock Manufacturing Co., Limited, Kitchener, Ont. Architect—C. Cowan. Roofer—Brown Jarvis Roofing Co., Brantford Ont.

Barrett Specification Roof on Athelma Apartments, Toronto, Ont. Roofer—Reggin & Spence, Toronto.

We issue this Surety Bond Guaranty merely as a means of impressing upon you our confidence in Barrett Specification Roofs. The guaranty is your assurance that you have on your building a roof that will need no attention and will give you complete, unqualified satisfaction for twenty years at least, *and probably much longer.* All you need to do to have such a roof is to incorporate in your building specification this sentence: "The roof shall be laid according to The Barrett Specification dated May 1, 1916, and the contractors shall obtain for us the Barrett 20-Year Guaranty Bond."

There is no charge for this Bond. It is obtainable on any roof of fifty squares or larger in towns of 25,000 or more, and in smaller places where our Inspection Service is available.

It will be issued to reputable roofing contractors, approved by us, who use the materials specified and who will agree to examination and approval by our inspectors. Barrett Specification Roofs cost less per year of service than any other kind; they take the base rate of fire insurance; in fact, any way you look at it, a Barrett Specification Roof is the best roofing made for permanent buildings.

A copy of the Barrett 20-Year Specification, with roofing diagrams, sent free on request.

The Barrett Company LIMITED

MONTREAL TORONTO WINNIPEG VANCOUVER
ST. JOHN, N.B. HALIFAX N.S. SYDNEY, N.S.

Sandwich, Ont.—Separate tenders will be received until 8 p.m., July 14th, by E. R. North, clerk, Sandwich, Ont., for supplying all labor, tools and materials necessary for the following works: a reinforced concrete pavement, 24 ft. wide, with curbs, on Centre Rd.; a 15-in. vitrified crock sewer on the Huron line, from Victoria St. southerly for a distance of 750 ft.; a 12-in. vitrified crock sewer on Brock St., from Baby St. to the Bloomfield Rd.; a 12-in. vitrified sewer on Tournier St.

St. John, N.B.—Bonds will be issued for $161,500 to meet expenditure for renewal of water mains. Commissioner Jones.

St. John, N.B.—Tenders will be received by H. E. Wardroper, clerk, until July 14th for 640 tons 16-inch cast-iron pipe, 210 tons 12-inch cast-iron pipe, 16 tons 10-inch cast-iron pipe, 40 tons 8-inch cast-iron pipe, 13 tons 6-inch cast-iron pipe, about 25 tons special castings, 25 16-inch gate valves, 8 12-inch gate valves, 2 10-inch gate valves, 11 8-inch gate valves, 25 6-inch gate valves, 22 fire hydrants and other small fittings. John B. Jones, commissioner W. and S. Adam P. Macintyre, comptroller.

Toronto, Ont.—Tenders will be received until noon, July 21st, by T. L. Church, chairman, board of control, for the construction and delivery of 16-in. lapwelded steel pipe. Specifications and tender forms may be obtained upon application at the office of the water main extension section, department of works, room 320, city hall, Toronto.

Winnipeg, Man.—Sewers will be constructed by the city council in Brock St., Centennial St. and Pritchard Ave. Approximate cost, $8,587. C. J. Brown, city clerk.

Winnipeg, Man.—Separate tenders will be received until 3 p.m., July 14th, by C. J. Brown, city clerk, Winnipeg, for laying water mains on Centennial St., Lindsay St., Sandhurst Ave. and Sylvia St. Specifications and forms of tender may be obtained at the office of the city engineer, 223 James Ave.

York Township, Ont.—Contract for culvert on Fourth St., has been awarded to Johnson; contract price, $975. Rejected tender, Ritchie, $1,142. Frank Barber, county engineer.

York Township, Ont.—Contract for water works on Eglington Ave. has been awarded to Godson Contracting Co. Contract price, $35,008.75. Other tenders submitted, McKnight, $35,112.55; Orsiny, $51,358. Frank Barber, county engineer.

York Township, Ont.—The township council has passed necessary by-laws to lay approximately 30,000 feet of water mains through the north-east section of the township.

York Township, Ont.—The township of York will install water mains on Coulson Ave., Bernice Crescent, Eileen Ave., Mildred Ave., Lyndon Ave., Elvin Ave. and Scarlett Rd., at a cost of $31,300. W. A. Clark, clerk.

LIGHT, HEAT AND POWER

Belleville, Ont.—The hydro-electric power commission has decided to proceed with the erection of the 44,000-volt tie line from Healey Falls to Peterboro' this season, which will make it possible for Havelock, Norwood and Hastings to have hydro service.

Brantford, Ont.—The Electric Tin Products Co. will establish a plant in this city. An electric smelting system will be established.

Calgary, Alta.—The Calgary Power Co. plans further development of water power.

Cobalt, Ont.—Tenders will be called soon for building a dam across the south-west corner of Sasaginaga Lake. O. Flanagan, of the Mining Corporation of Canada, will prepare specifications. Estimated cost, $4,500.

Edmonton, Alta.—The department of public works has awarded contract for plumbing and heating for agricultural schools at Raymond, Youngstown and Gleichen, to Ross Bros. Plumbing and Heating Co., Edmonton. Tender price, $11,000 each. Rejected tenders for Raymond: R. A. Bond and Co., Medicine Hat, $12,509; Jas. H. Reive, Medicine Hat, $12,550; Walker and Holberton, Lethbridge, $13,225; J. A. Lockerbie, Ltd., Edmonton, $13,456; Marsh and Scott, Medicine Hat, $13,355; Campbell and Hillier, Calgary, $13,700; Jas. Ballantyne and Co., Calgary, $13,750; N. Turner and Co., Calgary, $13,920; Hick-Sehl Hardware Co., Lethbridge, $17,207. For Youngstown Jas. H. Reive, Medicine Hat, $12,450; J. A. Lockerbie, Ltd., Edmonton, $13,370; Campbell and Hillier, Calgary, $13,700; Jas. Ballantyne and Co., Calgary, $13,600; T. B. Rogers, Calgary, $14,086. For Gleichen: Jas. H. Reive, Medicine Hat, $12,350; J. A. Lockerbie, Ltd., Edmonton, $13,370; Marsh and Scott, Medicine Hat, $13,355; R. J. Priestly and Son, Calgary, $14,241; Jas Ballantyne and Co., Calgary, $13,500.

Edmonton, Alta.—Electrical contract for agricultural schools at Raymond, Youngstown and Gleichen has been awarded by the department of public works, to H. H. Depew, Edmonton. Tender prices, Raymond, $1,163.40; Youngstown, $1,127.20; Gleichen, $1,138.40. Rejected tenders, for Raymond: Bert. L. Perry, Ltd., Edmonton, $1,294; Burnham Frith Electric Co., Edmonton, $1,303; Hillas Electrical Co., Edmonton, $1,399; MacKillop Electric Co., Edmonton, $1,843; W. L. McKenzie and Co., Lethbridge, $1,939; C. H. Cooke, Lethbridge, $1,990. For Youngstown: Bert. L. Perry, Ltd., Edmonton, $1,268; Burnham Frith Electric Co., Edmonton, $1,303; Hillas Electric Co., Edmonton, $1,394; MacKillop Electric Co., $1,830. For Gleichen: Bert L. Perry, Ltd., Edmonton, $1,250; Burnham Frith Electric Co., Edmonton, $1,303; Hillas Electric Co., Edmonton, $1,440; MacKillop Electric Co., Edmonton, $1,830.

Fort Qu'Appelle, Sask.—Tenders will be received by the Saskatchewan Anti-Tuberculosis League, until July 31st, for boilers and brick settings. Official advertisement in this issue.

Gowganda, Ont.—The installation of a steam-driven mining plant is proceeding on the former property of the LeRoy Lake syndicate in the Gowganda district. The erection of the power house is nearing completion.

Ottawa, Ont.—Tenders will be received until July 15th, by H. F. McNaughton, secretary, department of public works, Toronto, Ont., for heating, ventilating and plumbing of the main building, agricultural school, Kemptville, and for alterations to the steam heating, ventilation and plumbing in the normal school, Ottawa. Plans and specifications for the former can be seen at the agricultural school, Kemptville, and for the latter at the normal school, Ottawa, and for both at the department of public works.

Pembroke, Ont.—The Pembroke Electric Light Co. plan extensions to system.

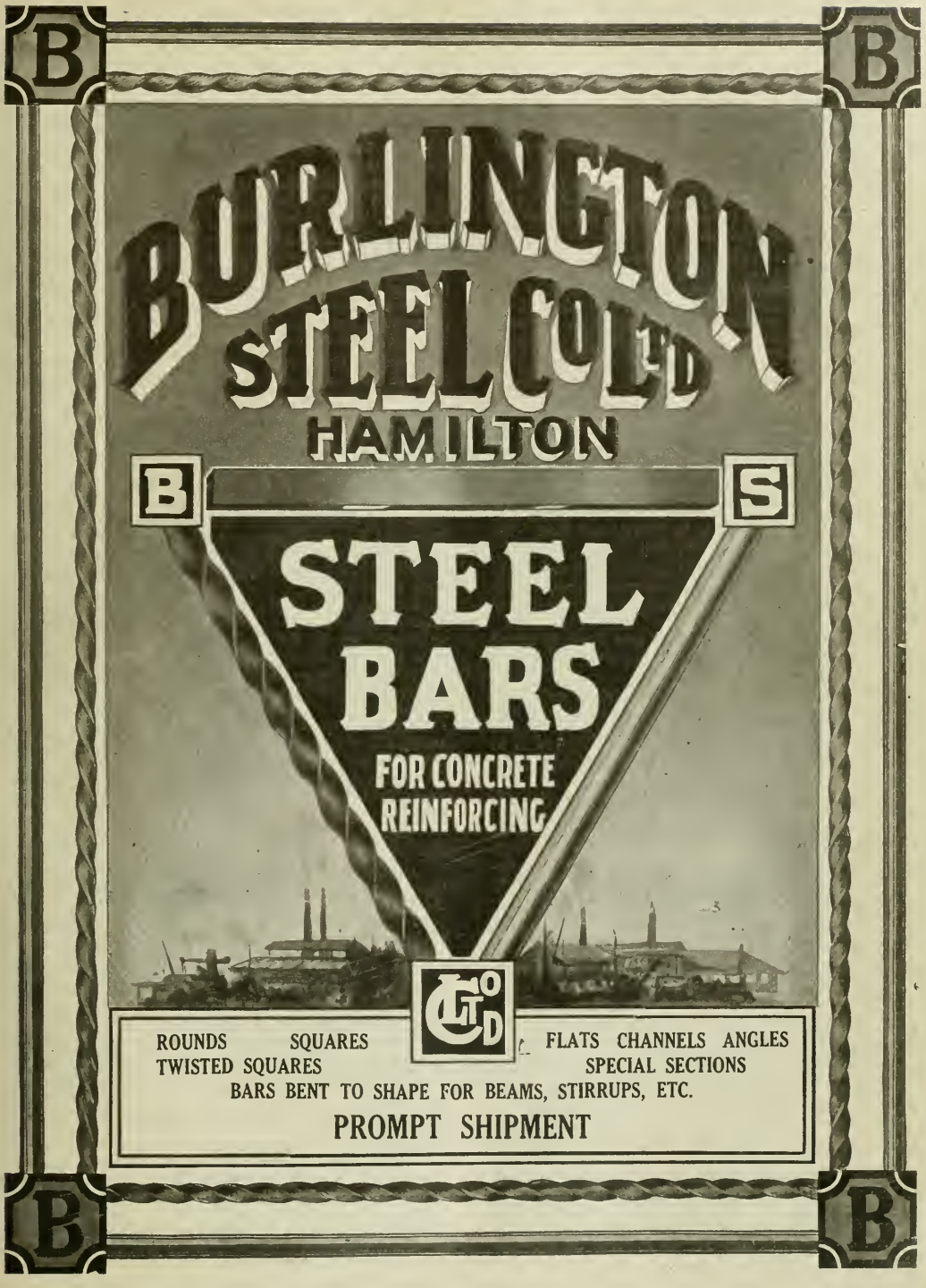
Stewart, B.C.—E. R. Workman, Stewart, B.C., contemplates using five cu. ft. per second out of a glacier-fed stream draining into Portland Canal. The water will be diverted from the stream at a point about seven hundred feet easterly from the Portland Canal, and will be used for power purpose.

Vermilion, Alta.—The town council has placed an order with the Canadian Westinghouse Co. for the purchase of a 100 k.w. generator and accessories. An order has also been placed with the Northern Electric Co. for equipment for the plant and outside service. Inspection has been made of the wiring system and it has been found advisable to repair it.

Weyburn, Sask.—Tenders will be received until July 26th by R. W. Clarke, secretary, Weyburn S.D. No. 512, for the heating, ventilating and plumbing plants for the new school to be erected. Plans to be secured from the secretary or from Storey and Van Egmond, architects, Regina.

RAILWAYS

Oshawa, Ont.—It has been decided to install new switch off Ritson Rd. into the proposed new plants of the General Motors and Steel Products Co., and for extension to track by the Oshawa Railway on Duke St.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STEEL CO LTD
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ROUNDS SQUARES FLATS CHANNELS ANGLES
TWISTED SQUARES SPECIAL SECTIONS
BARS BENT TO SHAPE FOR BEAMS, STIRRUPS, ETC.
PROMPT SHIPMENT

Ottawa, Ont.—A railway subsidy has been granted by parliament to the Edmonton, Dunvegan and British Columbia Railway for construction of a line from Spirit River settlement through the Grand Prairie land district of Alberta, the amount being $258,797. The sum of $300,000 is provided for Hudson Bay railway construction, and $550,000 for Quebec and Saguenay Railway construction.

St. Thomas, Ont.—Contract for 100 tons of girder rails and rail joints has been awarded to the United States Steel Products Co., at $66 per ton.

Trail, B.C.—It is possible that the seven-mile link, from Columbia Garden to Trail, may soon be constructed. This route was surveyed some years ago by the C.P.R., with a bridge crossing at Rock Island.

Winnipeg, Man.—Tenders will be received until noon, July 18th, for grading and building culverts from mile 101.5 to mile 115.5, Thunderhill Extension. Plans, profiles and specifications can be seen and form of tender obtained at the office of the chief engineer, Winnipeg; district engineer, Saskatoon, and district engineer, Edmonton. H. A. Dixon, chief engineer, Canadian National Railways, Winnipeg, Man.

FACTORIES AND LARGE BUILDINGS

Barrie, Ont.—Bulk tenders have been received by the town council for remodelling west ward school from R. F. Garrett at $69,980 and from the Ball Planing Mill Co. at $66,719. Included in the latter is $10,979 for heating and ventilating systems to be put in by Moffatt and Parr. The contract has been awarded to The Ball Planing Mill Co.

Bedford, Que.—Tenders will be received until noon, July 15th by E. M. J. Lamoureux, secretary-treasurer, county council of Missisquoi, Bedford, Que., for repairs to county building.

Cobalt, Ont.—Arrangements have been made to install a mill at the Ontario-Kirkland mine. The plant will have a capacity for treating 100 tons daily.

Donnacona, Que.—Tenders will be received until July 20th, for the building of a 150-ton pulp and paper mill; also fully equipped power plant to develop 5,000 h.p. on Jacques Cartier River. Plans and specifications upon application to "Pulp and Paper," Room 40, Toronto Stock Exchange Building, Toronto.

Edmonton, Alta.—The department of public works, Edmonton, Alta., has awarded general contract for agricultural schools at Raymond, Youngstown and Gleichen, to Smith Bros. and Wilson, Lethbridge. Tender prices: Raymond, $47,400; Youngstown, $48,600; Gleichen, $48,000. Rejected tenders: For Raymond, C. C. Potter and Co., Medicine Hat, $58,032.90; Mildman and McKellar, Taber, $58,750. For Youngstown, Bennett and White Construction Co., Calgary, $48,000; Thomas, Jamieson, McKenzie, Ltd., Calgary, $49,750; C. C. Potter and Co., Medicine Hat, $57,932.90.

Edmonton, Alta.—Pheasey and Batson have been awarded the contract for addition to Parkdale school. Tender price, $15,311.

Edmonton, Alta.—Contract for eight portable frame schools has been awarded to J. A. Peters. Tender price, $1,659 each.

Edmonton, Alta.—The Massey-Harris Co. has taken out a building permit for warehouse. Estimated cost, $12,000. S. F. Toby has the contract.

Edmonton, Alta.—The J. I. Case Threshing Machine Co. will erect machinery warehouse on 93rd St. Contract has been let to W. C. McArthur.

Elmira, Ont.—Great West Felt Co. has awarded contract for the erection of a $25,000 factory, to W. Hallman, Galt.

Ford City, Ont.—The Westcott Contracting Co. have the contract for erection of plant for the Imperial Oil Co. Approximate cost, $100,000.

Goderich, Ont.—The Convertible Tractor Corporation, of St. Paul, Minn., contemplates the erection of a manufacturing plant.

Guelph, Ont.—The Y.W.C.A. contemplate erection of building. Estimated cost, $30,000.

Halifax, N.S.—Bulk tenders will be received until noon, July 14th, by S. P. Dumaresq, architect, 14 Prince St., Halifax, for the erection and completion of a proposed building for the Navy League of Canada, corner of South and Barrington Streets.

Hamilton, Ont.—Debentures will be issued to the amount of $33,000 for repairs to central school. H. H. Lazier, chairman, board of education.

Hope, B.C.—Tenders will be received until noon, July 15th, by A. E. Foreman, engineer, public works department, Victoria, B.C., for the erection and completion of a six-room building. Plans and specifications can be seen at the office of the provincial constable at Hope, of J. Mahoney, Esq., government agent, court house, Vancouver, and the department of public works, Victoria.

London, Ont.—John Hayman and Sons have been awarded the contract for erection of a new theatre for Allens' Theatres, Ltd.

London, Ont.—Philip Secord, of Brantford, has been awarded the contract for the new Loew's Theatre, to be erected on Queen's Ave.

London, Ont.—The C. S. Hyman Co., tanners, will erect new building on George St.

London, Ont.—The Holeproof Hosiery Co., Bathurst and Clarence Streets, has awarded contract for building to the Stone and Webster Contracting Co., Boston, Mass. The new building will cost about $300,000, and it is said that the American firm agreed to erect it at $50,000 less than any local contractor.

Melfort, Sask.—Plans have been prepared by J. H. Puntin, architect, for a new creamery and cold storage plant, to be constructed by the Saskatchewan Co-operative Creameries Co. Probable cost, $50,000.

Montreal, Que.—A new school will be erected on Morgan Boulevard by the Protestant school board. Estimated cost, $300,000.

Montreal, Que.—F. A. Groth, 6 Cuthbert St., has been awarded a contract for additions to shops for the Montreal Tramway Co. Tender price, $7,000.

Montreal, Que.—The Maple Leaf Theatre Co., St. Lawrence Blvd., contemplates alterations at a cost of about $40,000.

Oshawa, Ont.—Four-room addition will be erected to Mary St. school. Mr. Smith, chairman, board of education.

Ottawa, Ont.—Votes of parliament for new public buildings include $400,000 for a new public building at London, Ont.; $24,000 for the Montreal post office; $23,000 for a new public building at Oshawa; $28,000 for an addition to the public building at St. Catharines; $115,000 to complete postal station "A," Toronto; $25,000 for improvements to public building at Portage la Prarie, Man.; $20,000 for a new public building at Kamloops, B.C.; and $10,500 for improvements to postal station "A" at Winnipeg.

Port Arthur, Ont.—Contract for the Hill St. school has been awarded to Captains King and Jenkins, Port Arthur, Ont.

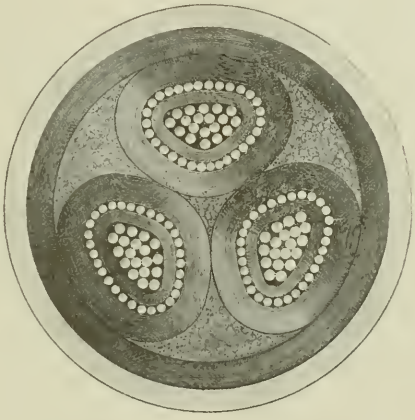
Regina, Sask.—Extensions will be made to R.N.W.M.P. barracks. New officers' quarters will be erected. Commissioner Perry.

Salt Springs, N.S.—The Canadian National Railways will erect station and freight shed.

Sarnia, Ont.—Tenders will be received until July 11th by James D. Stewart, city clerk, Sarnia, Ont., for the construction of a brick building and certain concrete work at the Point Edward water works. F. W. Thorold Co., Ltd., consulting engineers, 167 Avenue Road, Toronto.

Sault Ste. Marie, Ont.—Time for receiving tenders for court house has been extended to July 15th.

SPLIT-CONDUCTOR CABLES



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MONTREAL

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Sherbrooke, Que.—G. Chauvin, 98 Darling St., Montreal, has been awarded the contract for a $50,000 factory for the Dominion Carriage Co., Ltd.

St. Hyacinthe, Que.—The Casavants Phonograph Co. plans extensive alterations and additions to factory.

St. John, N.B.—Tenders will be received by Henry Hedden, M.D., secretary of the board of commissioners, until noon, July 14th, for the construction of a nurses' residence at the general public hospital. Plans and specifications may be seen at the office of the architect, F. Neil Brodie, 42 Princess St.

St. Robert, Que.—Contract for school has been awarded to D. Ethier, St. Jude's, Que.

Vancouver, B.C.—The construction of an experimental plant as an adjunct to the University of British Columbia, is contemplated by the department of mines. Hon. Wm. Sloan, minister of mines, British Columbia.

Walkerville, Ont.—The American Auto Trimming Co. will erect addition to plant. Cost about $160,000. The Westcott Contracting Co. has been awarded the contract.

Weyburn, Sask.—Tenders will be received until July 26th, by R. W. Clarke, secretary, S.D. No. 512, Weyburn, Sask., for the erection of a school building. Plans may be secured from the secretary, or from Storey and Van Egmond, architects, Regina.

Winnipeg, Man.—Bulk and separate tenders will be received by E. D. Tuttle, architect, McArthur Bldg., Winnipeg, until noon, July 14th, for the rebuilding of the Makaroff consolidated school.

York Township, Ont.—Building permits for the month of June amounted to $425,000. Wm. Dever, township building inspector.

MISCELLANEOUS

Bare Point, Port Arthur, Ont.—The department of public works has awarded contract for construction of section of breakwater to Chambers, McQuigge and McCaffrey, Port Arthur. Under the name of the Nipigon Construction Co., the same people executed upwards of $7,000,000 work on the National Transcontinental Railway on the section north of Nipigon Lake.

Berthier, Que.—Tenders will be received until noon, July 24th, by R. C. Desrochers, secretary, department of public works, for repairs to wharf.

Burlington, Ont.—Contract for repairs to south pier has been awarded by the department of public works to Ottawa Contractors, Ltd., Ottawa.

Calgary, Alta.—Contract for stream diversions at mile 324 and 332, Calgary sub-division, has been awarded by Canadian National Railways to Carter, Halls, Aldinger Co., Ltd., Winnipeg. It is estimated that the diversion at mile 324 contains 60,000 yards, and mile 332, 17,000 yards.

Cornwall, Ont.—Tenders will be received until noon, July 22nd, by R. C. Desrochers, secretary, department of public works, Ottawa, for the construction of a wharf. Plans and forms of contract can be seen and specification and forms of tender obtained at the department of public works, at the office of the district engineer, Shaughnessy Building, Montreal, Que., and at the post office, Cornwall, Ont.

Edmonton, Alta.—Contracts will be awarded this week for the construction of about 400 miles of telephone lines in different parts of the province. Tenders for this work were called by the railway and telephone department a few weeks ago, and a large number of contractors have submitted tenders. Among the number will be lines from Pembina to Fort Assiniboine, in the north country; Edmonton to Clyde; Coronation to Veteran; Castor to Garden Plains; Medicine Hat to Hilda, and Retlaw to River Bow. The cost of the entire program is estimated at about $60,000.

Esquimalt, B.C.—The Federal government will expend $500,000 this year for construction of drydock. The total cost is estimated at about $4,000,000. Tenders will be called at once.

Fort William, Ont.—The Thunder Bay Contracting Co., of which Lieut.-Col. Little is manager, has been awarded the contract for driving the piles for the revetment wall.

Half Moon Bay, B.C.—Tenders will be received until noon, July 23rd, by R. C. Desrochers, secretary, department of public works, Ottawa, for the construction of a wharf in the Comox-Atlin District, B.C. Plans and forms of contract can be seen and specifications and forms of tender obtained at the department of public works, at the office of the district engineer, Victoria, B.C., and at the post offices, Vancouver, B.C., and Comox, B.C.

Nanaimo, B.C.—The Granby Consolidated Mining, Smelting and Power Co., Ltd., will construct wharf on Vancouver Island. F. M. Sylvester, managing director.

Nelson, B.C.—Extensive development work is to be carried out soon at the Whitewater and Comstock groups on Cascade Creek, in the Lardo district, and the Nonpareil group at Zincton. The properties belong to the Nelson Mining and Development Co., Spokane. W. W. Shaffner, general manager.

North Arm, B.C.—Tenders will be received until noon, July 30th, by R. C. Desrochers, secretary, department of public works, Ottawa, for dredging at North Arm, Fraser River, B.C. Combined specification and form of tender can be obtained on application to the secretary, department of public works, Ottawa, and at the office of the district engineer, New Westminster, B.C.

Ottawa, Ont.—Harbor and river votes by parliament include the following items: Esquimalt, new dry dock, $500,000; Port Arthur and Fort William, harbor improvements, $200,000; to complete Champlain dry dock, Quebec, $207,000; River St. Charles, improvements, Quebec, $55,800; St. John harbor improvements, $250,000; Toronto harbor improvements, $200,000; Toronto breakwater protection, $200,000; Vancouver harbor improvements, $18,000; Victoria harbor improvements, $21,000; $100,000 for a wharf at Sydney, N.S.; $82,000 to complete protection works at Laprairie, Que.; $50,000 for breakwater reconstruction at Collingwood, $34,000 for wharf renewal at Depot Harbor; $100,000 for harbor improvements at Hamilton; $54,000 for rebuilding wharf at Little Current; $33,000 harbor improvements, Port Stanley; $86,000 wharf construction, Owen Sound; $50,000 harbor improvements, Port Dover; $48,000 breakwater extension at Thessalon; western votes include $50,000 for dredging the North Arm of the Fraser River and $36,000 for improvements at Nicomen Island.

Ottawa, Ont.—$10,000,000 has been voted by parliament for construction of vessels.

Port Colborne, Ont.—Contract has been awarded by department of public works, for repairs to breakwater, to J. M. Hogan, Port Colborne.

Port Essington, B.C.—Tenders will be received until noon, July 31st, by R. C. Desrochers, secretary, department of public works, for float and approach.

St. Anne de Beaupre, Que.—Tenders will be received until noon, July 23rd, by R. C. Desrochers, secretary, department of public works, Ottawa, for repairs and reconstruction of wharf. Plans and forms of contract can be seen and specifications and forms of tender obtained at the department of public works, at the offices of the district engineers, post office, Quebec, P.Q., Shaughnessy Building, Montreal, P.Q., and at the post office, Ste. Anne de Beaupre, P.Q.

Toronto, Ont.—Plans are being prepared by city architect Pearse for livestock arena to be erected at the exhibition grounds.

Toronto, Ont.—The board of control has recommended the completion this year of the western water front improvements and the extension of the exhibition sea wall. Estimated cost, $487,000.

Toronto, Ont.—$200,000 has been voted by the government in the supplementary estimates for harbor improvements, and will be devoted to carrying on the work already in progress, particularly in the Sunnyside area. Further crib work in front of the exhibition grounds and in the western section and Ashbridge's Bay will also be done.

The Canadian Engineer

A Weekly Paper for Civil Engineers and Contractors

Convenient Method of Calculating Trash Racks

Table and Formulae by Means of Which Designers Can Readily Determine Lengths of Panels Between Supports for Various Spacings and Sizes of Bars—Structural Details and General Suggestions Regarding the Design of Racks

By E. BALBACH
Assistant Engineer, The James Leffel & Co.

IN calculating trash racks, we should assume that they may become completely clogged and will therefore be subject to the full hydrostatic pressure due to the head of water.

As this is the worst possible case that can occur, the structure will be safe if the stress in the bars for this condition is within the elastic limit of the material used, and we can therefore use a stress as high as 30,000 lbs. in our calculations. However, for the basis of these calculations we will assume a stress of 25,000 lbs. with full hydrostatic pressure imposed.

The pressure at any point will be directly proportional to its depth below the surface; i.e., the load on any bar will be represented by a triangle with the point or apex at the surface of the water.

For any given pitch or spacing of bars, then, the free span, or distance between supports for rack bars, is determined from the resisting moment of the bar used.

Using the notation given in Fig. No. 1, the length between the different supports can be determined as follows:—

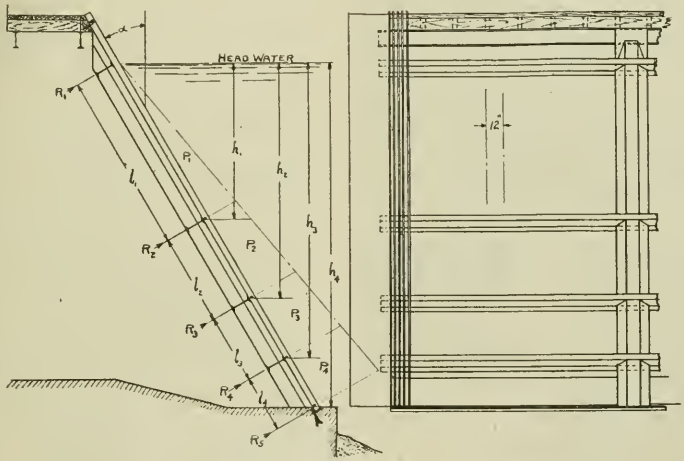


FIG. NO. 1—DIAGRAM INDICATING NOTATIONS IN FORMULAE

We will call these distances panel lengths and indicate them by l_1, l_2, l_3, l_4, etc., all in inches.

The loads P_1, P_2, etc., are for a width equal to the pitch of the bars. For the first panel, or l_1, the moment due to the load can be represented by

$$M_1 = 0.128 P_1 l_1 \quad \ldots\ldots (1)$$

where P_1 = total pressure on one bar;

l_1 = distance between supports in inches, considering ends free.

The resisting moment of the bar is

$$M_{r_1} = \tfrac{1}{6} b d^2 \times 25{,}000 \quad \ldots\ldots (2)$$

Where b = thickness of bar in inches;

d = depth of bar in inches; and the dangerous section will be at a distance

$$x = 0.5774 l_1 \quad \ldots\ldots (3)$$

from top support. The spacing bolts should be spaced to avoid this section, so as not to weaken the bar. The load

$$P_1 = 0.434 l_1 p h_1 / (12 \times 2).$$

Therefore,

$$P_1 = 0.0181 l_1^2 p \cos\alpha$$

where p = spacing of bars; $h = l_1 \cos\alpha$; and $\cos\alpha = \cos 30$ degs., generally 0.866.

By substituting for $\cos\alpha$,

$$P_1 = 0.0157 l_1^2 p \quad \ldots\ldots (4)$$

Substituting equation (4) in equation (1), we get

$$M_1 = 0.128 \times 0.0157 l_1^2 p = 0.00201 l_1^2 p \quad \ldots\ldots (5)$$

Equating (2) and (5), we get

$$0.00201 l_1^2 p = 25{,}000 bd^2/6 = 4{,}170 bd^2 \quad \ldots\ldots (6)$$

Now by assuming values at will for p, b and d, we have a cubic equation in l_1. By solving for l_1 we have the maximum allowable distance between supports for panel length No. 1. To carry the problem through we will assume a spacing of bars $p = 1\frac{1}{4}$ ins., centre to centre, and a bar ¼ in. by 2½ ins.

Substituting these values in equation (6), we get

$$0.00201 l_1^2 \times 1.25 = 4{,}170 \times 0.25 \times 2.5^3 \quad \ldots\ldots (7)$$

Therefore, $l_1^3 = (4{,}170 \times 0.25 \times 2.5^3) \div (0.00201 \times 1.25) = 2{,}590{,}000 \quad \ldots (8)$

Consequently, $l_1 = (2{,}590{,}000)^{1/3} = 135.5$ ins.

The perpendicular distance, or head, $h_1 = l_1 \cos\alpha = 135.5 \times 0.866 = 117.4$ ins.

Second Panel

Theoretically the second panel, or l_2, should be calculated as a continuous beam if the bars do not end at the lower support of the second panel, but, as frequently is the case, the total length of rack is divided into several panels and would therefore not be continuous, so we will again assume free ends. This assumption will in some cases give us a shorter length for l, but the discrepancy will be on the side of safety.

The load on the second panel will be represented by a trapezoid of which the shorter leg will be the same as the base of the upper triangle (for panel l) and the lower leg will be increased by the increment due to additional head. This loading can be subdivided into two loads, one a parallelogram with height equal to the short leg of the

trapezoid, and the other a triangle similar to that on first panel.

Let these loads be P_2 and P_2'. The moment will then be the sum of the two moments produced by these loads.

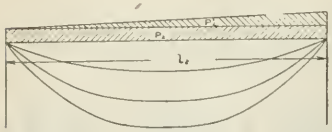


FIG. No. 2—LOADING ON No. 2 PANEL

Theoretically this is not correct because the maximum moment produced by each load does not occur at the same point. The maximum moment due to load P_2 occurs at the middle, while that due to load P_2' occurs $0.5774l_2$ from the upper support, or $0.0774l_2$ from the middle. Therefore the moment at the middle for load P_2' will be somewhat less, and the sum of the moments at the middle will be somewhat less, than that given in equation (9). For simplicity, however, we will assume the bending moment to be the sum of the two moments, as the difference is but small and the error gives us a safer result.

$$M_2 = \tfrac{1}{8}P_2l_2+0.128P_2'l_2 \quad \ldots\ldots (9)$$

in which

$$P_2 = 0.434h_1l_2p/12,$$

and

$$P_2' = \tfrac{1}{2}[(0.434h_1/12)+(0.434h_2/12)]l_2p$$

in which $h_2 = h_1+l_2\cos\alpha = 117.4+l_2\cos\alpha$.

Substituting the values of h_1 and h_2, we get

$$P_2 = \tfrac{1}{12}\times 0.434\times 117.4l_2p = 4.25l_2p \quad \ldots\ldots (10)$$

$$P_2' = [(\tfrac{1}{12}\times 0.434\times 117.4)+(\tfrac{1}{12}\times 0.434)(117.4+l_2\cos\alpha)]\tfrac{1}{2}l_2p$$
$$= [4.25+0.0362(117.4+l_2\cos\alpha)]\tfrac{1}{2}l_2p \quad \ldots\ldots (11)$$

The resisting moment as before is

$$M_{r_2} = 4{,}170bd^2 \quad \ldots\ldots (12)$$

Substituting the values of (10) and (11) in equation (9), we get

$$M_2 = (\tfrac{1}{8}\times 4.25l_2^2p)+(\tfrac{1}{2}\times 0.128l_2^2p)[4.25+0.0362(117.4+l_2\cos\alpha)]$$

Reducing and substituting for p and $\cos\alpha$, we get

$$M_2 = 0.664l_2^2+0.08l_2^2(4.25+4.25+0.0314l_2)$$
$$= 0.664l_2^2+0.68l_2^2+0.002515l_2^3$$
$$= 1.344l_2^2+0.002515l_2^3 \quad \ldots\ldots (13)$$

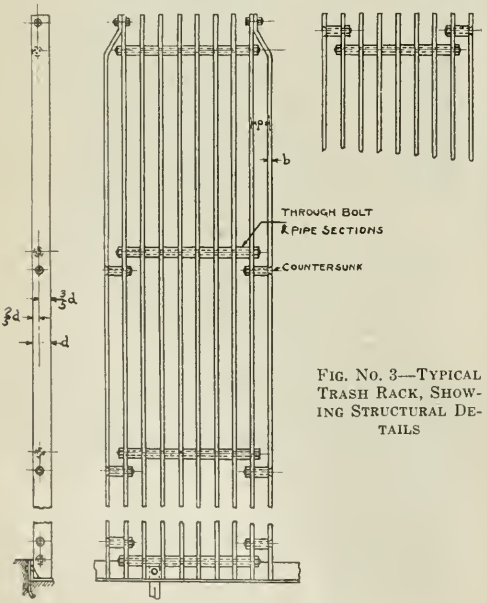


FIG. No. 3—TYPICAL TRASH RACK, SHOWING STRUCTURAL DETAILS

Equating (12) and (13), we get

$$1.344l_2^2+0.002515l_2^3 = 4{,}170bd^2 = 6{,}660 \quad \ldots\ldots (13a)$$

Solving for l_2 by trial, we get

$$l_2 = 67 \text{ ins.}$$

and

$$h_2 = h_1+l_2\cos\alpha$$
$$= 117.4+(67\times 0.866)$$
$$= 174 \text{ ins.}$$

Third Panel

The load on the third panel, or l_3, will be represented by a trapezoid, as in the second panel, with the short leg equal to the long leg of the trapezoid on second panel, and the long leg increased by the increment due to the additional head. This loading can likewise be divided into two loads, as in the case of the second panel.

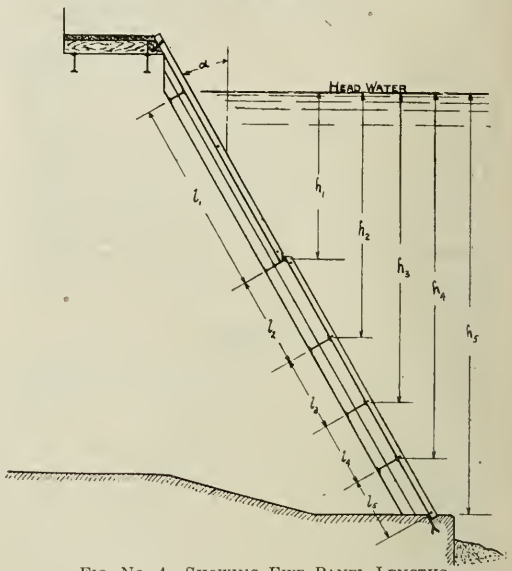


FIG. No. 4—SHOWING FIVE PANEL LENGTHS

Let these loads be P_3 and P_3'.

Then,

$$M_3 = \tfrac{1}{8}P_3l_3+0.128P_3'l_3 \quad \ldots\ldots (14)$$

in which

$$P_3 = \tfrac{1}{12}\times 0.434h_3l_3p$$

and

$$P_3' = \tfrac{1}{2}[(0.434h_3/12)+(0.434h_1/12)]l_3p$$

in which

$$h_3 = h_2+l_3\cos\alpha$$
$$= 174+l_3\cos\alpha$$

Substituting values for h_2 and h_3, we get

$$P_3 = \tfrac{1}{12}\times 0.434\times 174l_3p = 6.3l_3p \quad \ldots\ldots (15)$$

$$P_3' = [(\tfrac{1}{12}\times 0.434\times 174)+(\tfrac{1}{12}\times 0.434)(174+l_3\cos\alpha)]\tfrac{1}{2}l_3p$$
$$= [6.3+0.0362(174+l_3\cos\alpha)]\tfrac{1}{2}l_3p \quad \ldots\ldots (16)$$

The resisting moment, as before, is

$$M_{r_3} = 4{,}170bd^2 \quad \ldots\ldots (17)$$

Substituting values of (15) and (16) in equation (14), we get

$$M_3 = (\tfrac{1}{8}\times 6.3l_3^2p)+(\tfrac{1}{2}\times 0.128l_3^2p)(6.3+6.3+0.0314l_3)$$

Reducing and substituting for p, we get

$$M_3 = 0.985l_3^2+1.01l_3^2+0.002515l_3^3$$
$$= 1.995l_3^2+0.002515l_3^3 \quad \ldots\ldots (18)$$

Equating (17) and (18), we get

$$1.995l_3^2+0.00252l_3^3 = 4{,}170bd^2 = 6{,}660.$$

Solving for l_3 by trial, we get

$$l_3 = 56 \text{ ins.}$$

and

$$h_3 = h_2+l_3\cos\alpha$$
$$= 174+(56\times 0.866) = 288 \text{ ins.}$$

Fourth Panel

The load on the fourth panel, l_4, is similar to that on the second and third panels. Let these loads be P_4 and P_4'. Then

$$M_4 = \tfrac{1}{8}P_4l_4+0.128P_4'l_4 \quad \ldots\ldots\ldots\ldots\ldots\ldots (19)$$

in which

$$P_4 = \tfrac{1}{12}\times 0.434h_3l_4p$$

and

$$P_4' = \tfrac{1}{2}[(0.434h_3/12)+(0.434h_4/12)]l_4p$$

in which $h_4 = h_3+l_4\cos\alpha = 228+l_4\cos\alpha$.

Substituting the values of h_3 and h_4, we get

$$P_4 = \tfrac{1}{12}\times 0.434\times 228l_4p = 8.23l_4p \quad \ldots\ldots\ldots (20)$$

$$P_4' = \tfrac{1}{2}[(\tfrac{1}{12}\times 0.434\times 228)+(\tfrac{1}{12}\times 0.434)(228+l_4\cos\alpha)]l_4p$$
$$= \tfrac{1}{2}[8.23+0.0362(228+l_4\cos\alpha)]l_4p \quad \ldots\ldots\ldots (21)$$

The resisting moment, as before, is

$$M_4 = 4{,}170bd^2 \quad \ldots\ldots\ldots\ldots\ldots\ldots (22)$$

Substituting values of (20) and (21) in equation (19), we get

$$M_4 = (\tfrac{1}{8}\times 8.23l_4^2p)+(\tfrac{1}{2}\times 0.128l_4^2p)(8.23+8.23+0.0314l_4)$$

Reducing and substituting for p, we get

$$M_4 = 1.29l_4^2+1.317l_4^2+0.00252l_4^3$$
$$= 2.607l_4^2+0.00252l_4^3 \quad \ldots\ldots\ldots\ldots\ldots\ldots (23)$$

Equating (22) and (23). we get

$$2.607l_4^2+0.00252l_4^3 = 4{,}170bd^2 = 6{,}660.$$

Solving for l_4 by trial, we get

$$l_4 = 49 \text{ ins.}$$

and

$$h_4 = h_3+l_4\cos\alpha$$
$$= 228+(49\times 0.866) = 270.5 \text{ ins.}$$

In this way the length of panels between supports can be determined for any spacing of bars and any size bar. The accompaning Table No. 1, gives these lengths for bars ¼ in. by 2 ins. to ¼ in. by 4 ins. and spacing of 1¼ ins. to 3 ins. inclusive.

If it be desired to use a bar thicker than ¼ in., the length of first panel can be obtained from the table as follows:—

Cube the length, l, corresponding to a bar of the same height, d, and spacing p, and multiply by the width of bar to be used. Then divide by the width of bar in table (¼ in.). Extract the cube root of this result, and this will be the desired length, l_1. See equation (8).

By examining equation (13a), it will be seen that the second term of the left hand member is of small value, and the first term is the controlling factor, and we can therefore say that the length varies as the square root and not as the cube root, with no appreciable error. We can therefore say that the length of all panels after the first vary as the square root of the resisting moment of the bar. As this moment is directly proportional to the thickness of the bar, the values of l_2, l_3, etc., can likewise be taken from the table by squaring the length given in table for a bar of the same height and spacing, and multiplying this result by the desired thickness, and dividing by the thickness used in the table (¼ in.), then extracting the square root and using the values of l_2, l_3, etc., so obtained.

For example, say it is desired to use a bar ⅜ in. by 3½ ins. instead of ¼ in. by 3½ ins., and a spacing of 2 ins. Then l_1 from table = 147 ins. Let l_1' = the desired length for ⅜ in. by 3½ ins. bar. Then

$$l_1' = (l_1^3\times 0.375/0.25)^{1/3}$$
$$= l_1(0.375/0.25)^{1/3}$$
$$= 147\times 1.145 = 168 \text{ ins.}$$

Let l_2' = second panel length. From table, l_2 = 69 ins. Therefore

$$l_2' = (l_2^3 0.375/0.25)^{1/3}$$
$$= l_2(0.375/0.25)^{1/3}$$
$$= 69\times 1.225 = 84.5 \text{ ins.}$$

Let l_3' = third panel length. From table, l_3 = 57.5 ins. Therefore

$$l_3' = (l_3^3\times 0.375/0.25)^{1/3}$$
$$= l_3(0.375/0.25)^{1/3}$$
$$= 57.5\times 1.225 = 70 \text{ ins.}$$

Let l_4' = fourth panel length. From table, l_4 = 51.5 ins. Therefore

$$l_4' = (l_4^3\times 0.375/0.25)^{1/3}$$
$$= l_4(0.375/0.25)^{1/3}$$
$$= 51.5\times 1.225 = 63 \text{ ins.}$$

Of course this is only true when the angle of the rack bar is 30 degs. from the perpendicular. For any other angle, the panel lengths should be determined from the foregoing equations by substituting the proper value for $\cos\alpha$.

The values here given in Table 1 will be safe for the worst conditions imaginable, because the stress used is inside the elastic limit of steel. If the designer wishes to use a different stress, he need only multiply l_1, from the table, by the cube root of the quotient, stress (S) divided by 25,000; that is, multiply l_1, from the table, by $(S/25{,}000)^{1/3}$ for the first panel length, and by $(S/25{,}000)^{1/3}$ for l_2, l_3, etc.

TABLE 1

Back Bar (Inches)	Resisting Moment*	Spacing of Bars in Inches	l_1	l_2	l_3	l_4	h_1	h_2	h_3	h_4
¼x2	4,170	1¼	118	58	48	42	102	152.5	194	230
¼x2½	6,660	1¼	135.5	67	56	49	117.4	174	228	270
¼x3	9,350	1¼	155	77	64	56	134	201	256	304
¼x3½	12,750	1¼	172	86	71	62	149	247	308	361
¼x4	16,650	1¼	188	94	78	68	163	245	312	371
¼x2	4,170	1½	111.5	55	45	39.5	96.5	144	183	217
¼x2½	6,660	1½	130	65	54	47	113	169	216	257
¼x3	9,350	1½	146	73	60.5	53	127	190	242	288
¼x3½	12,750	1½	161.5	81	67	59	140	210	268	319
¼x4	16,650	1½	176.5	88	73	64	153	229	292	347
¼x2	4,170	1¾	106	52	43	37	92	137	174	206
¼x2½	6,660	1¾	123	61	51	45	107	160	204	243
¼x3	9,350	1¾	138.5	69	57.5	50	120	180	230	273
¼x3½	12,750	1¾	153.5	76	63.5	55	133	199	254	301
¼x4	16,650	1¾	168	83	69	60	145.5	217	277	329
¼x2	4,170	2	103	48	40	36	89	131	166	197
¼x2½	6,660	2	118	56	47	43	102	150	191	228
¼x3	9,350	2	133	62.5	52	47	115	169	214	255
¼x3½	12,750	2	147	69	57.5	51.5	127	187	237	282
¼x4	16,650	2	160	75	62.5	56	139	204	258	306
¼x2	4,170	2¼	97.5	46	39	35	84	124	158	188
¼x2½	6,660	2¼	114	54	46	41	99	146	186	221
¼x3	9,350	2¼	127	60	51	46	111	163	207	247
¼x3½	12,750	2¼	141	66.5	56	50	122	179	227	270
¼x4	16,650	2¼	154.5	73	62	55	134	197	250	297
¼x2	4,170	2½	94	44.5	38	34	81.5	120	153	182
¼x2½	6,660	2½	110	52	44	39	95.5	140.5	178.5	212
¼x3	9,350	2½	123	58	49.5	44	106.5	156.5	199.5	237
¼x3½	12,750	2½	136	64.5	55	49	118	174	221.5	264
¼x4	16,650	2½	149	70.5	60	53.5	129	190	242	288
¼x2	4,170	2¾	91	43	37	33	79	116	148	177
¼x2½	6,660	2¾	106	50	43	38	92	135	172	205
¼x3	9,350	2¾	119	56	48	43	103	151.5	193	230
¼x3½	12,750	2¾	133	63	54	48	115	169.5	216	257
¼x4	16,650	2¾	144	68	58.5	52	125	184	234.5	279
¼x2	4,170	3	88.5	42	36	32	76.5	113	144	172
¼x2½	6,660	3	104	49.5	42.5	38	90	133	170	203
¼x3	9,350	3	116	55	47	42	100.5	148	188.5	225
¼x3½	12,750	3	128.5	61	52	46	111	164	209	249
¼x4	16,650	3	140	66.5	57	50	121	178.5	228	271

*$M = \frac{1}{6}\times bd^2\times 25{,}000$.

Construction of Panels

The bars are usually held together by through bolts, with sections of wrought-iron pipe of proper length strung between the bars, as shown in Fig. 3. The through bolt is placed back of the centre line of the bar so that the cleaning rake will not catch so readily.

The nuts on the bolts should not project outside the panel but should be guarded by a bar which is riveted at both ends. If this is done, the rack panels can be easily withdrawn and replaced.

The lower end of the rack bars can rest in an angle iron embedded in the concrete, and the upper end should be anchored by means of a hook engaging the spacing bars.

Supporting Structure

There are various methods for supporting the bars, depending on the construction of the adjacent building. If dividing walls can be placed at frequent intervals so as not to make too great a spacing, then I-beams can be embedded in these to support the racks. Such an arrangement is

shown in Figs. 1 and 3, where the walls stop behind the rack bars, so as not to obstruct the flow through the racks. The beams can then be determined from the conditions for uniform loading, and in Table 2 is given the loading per foot of length of beam. Where the spacing is too great for an economical beam, a steel truss can be placed midway between the walls.

TABLE 2—LOADS PER FOOT WIDTH OF RACKS

Bar (Inches)	P_1	P_2+P_2'	P_3+P_3'	P_4+P_4'	R_1	R_2	R_3	R_4	R_5
¼x2	2,610	3,210	3,610	3,860	870	3,250	3,395	3,730	2,045
¼x2½	3,450	4,230	4,890	5,285	1,150	5,290	4,535	5,075	2,800
¼x3	4,500	5,575	6,350	6,800	1,500	5,620	5,950	6,550	3,610
¼x3½	5,550	7,390	8,540	9,000	1,850	7,170	7,930	8,755	4,775
¼x4	6,650	8,250	9,400	10,100	2,217	8,308	8,785	10,740	5,350
⅓x2	2,330	2,870	3,190	3,430	775	2,905	3,020	3,300	1,820
⅓x2½	3,180	3,980	4,510	4,820	1,060	3,990	4,230	4,655	2,555
⅓x3	4,010	5,020	5,650	6,100	1,335	5,025	5,310	5,870	3,230
⅓x3½	4,900	6,140	6,950	7,510	1,633	6,147	6,520	7,415	3,985
⅓x4	5,860	7,300	8,250	8,860	1,953	7,337	7,740	8,550	4,690
⅜x2	2,110	2,580	2,900	3,050	703	2,620	2,627	2,975	1,615
⅜x2½	2,860	3,535	4,030	4,360	953	3,567	3,770	4,185	2,310
⅜x3	3,610	4,490	5,110	5,450	1,203	4,517	4,780	4,270	2,890
⅜x3½	4,425	5,480	6,230	6,620	1,475	5,525	5,835	6,410	3,510
⅜x4	5,300	6,350	7,400	8,010	1,767	6,518	6,835	7,690	4,250
¼x2	1,990	2,290	2,580	2,840	663	2,402	2,425	2,705	1,505
¼x2½	2,610	3,125	3,480	3,910	870	3,210	3,290	3,680	2,075
¼x3	3,320	3,850	4,320	4,775	1,107	4,023	4,070	4,530	2,535
¼x3½	4,050	4,700	5,290	5,800	1,350	4,910	4,970	5,535	3,075
¼x4	4,820	5,590	6,250	6,850	1,607	5,838	5,895	6,535	3,635
⅜x2	1,775	2,080	2,390	2,625	592	2,160	2,228	2,500	1,390
⅜x2½	2,450	2,870	3,320	3,620	817	2,983	3,080	3,460	1,920
⅜x3	3,060	3,570	4,100	4,540	1,020	3,720	3,815	4,305	2,410
⅜x3½	3,730	4,340	4,930	5,390	1,243	4,527	4,615	5,145	2,860
⅜x4	4,500	5,240	6,000	6,520	1,500	5,460	5,585	6,245	3,460
⅜x2	1,660	1,950	2,250	2,475	553	2,022	2,090	2,355	1,320
⅜x2½	2,275	2,660	3,040	3,310	758	3,767	2,840	3,165	1,755
⅜x3	2,840	3,310	3,825	4,170	947	3,448	3,350	3,985	2,215
⅜x3½	3,480	4,085	4,710	5,170	1,160	4,240	4,375	4,930	2,740
⅜x4	4,170	4,875	5,630	6,150	1,390	5,070	5,225	5,880	3,260
⅜x2	1,560	1,820	2,120	2,330	520	1,895	1,965	2,220	1,235
⅜x2½	2,110	2,460	2,870	3,110	703	2,562	2,650	2,985	1,650
⅜x3	2,660	3,095	3,590	3,950	887	3,228	3,325	3,760	2,095
⅜x3½	3,320	3,880	4,520	4,925	1,106	4,039	4,175	4,710	2,615
⅓x4	3,900	4,550	5,310	5,800	1,300	4,740	4,900	5,550	3,070
¼x2	1,465	1,730	2,010	2,200	488	1,790	1,862	2,100	1,165
¼x2½	2,030	2,400	2,790	3,080	677	2,483	2,580	2,935	1,625
⅓x3	2,550	2,970	3,430	2,860	850	3,095	3,185	3,165	1,515
⅓x3½	3,070	3,640	4,210	4,550	1,023	3,070	3,905	4,320	2,410
⅓x4	3,680	4,325	4,790	5,400	1,227	3,680	4,545	5,080	2,860

$R_1 = P_1/3$. $R_2 = 0.66P_1+0.47\ (P_2+P_2')$.
$R_3 = 0.53(P_2+P_2')+0.47(P_3+P_3')$.
$R_4 = 0.53(P_3+P_3')+0.47(P_4+P_4')$.
$R_5 = 0.53\ (P_4+P_4')$.

If the walls cannot be extended, then steel trusses will have to be built at intervals throughout the whole length of trash racks, and the beams supported on these.

In General

The effective area of the racks should be somewhat larger than the canal into which they lead, so as not to cause too great a loss in head.

The effective area will be the space between the bars multiplied by the perpendicular height. Allowance must also be made for obstruction by supporting beams and trusses.

The number of bars to make one panel is fixed by the the allowable weight and means for handling same when removing for cleaning, etc. Space the through bolts so that they come on a supporting beam and the bar will not be weakened.

Tenders will be received by the secretary of the Board of Control of Ottawa, Ont., until Tuesday, July 29th, for the supply of the following quantities of water meters: Fifty ⅝-in., twenty-five ¾-in., twenty-five 1-in., ten 1¼-in., fifteen 1½-in., seventy 2-in., thirty 3-in., ten 4-in., twelve 6-in. and four 8-in.

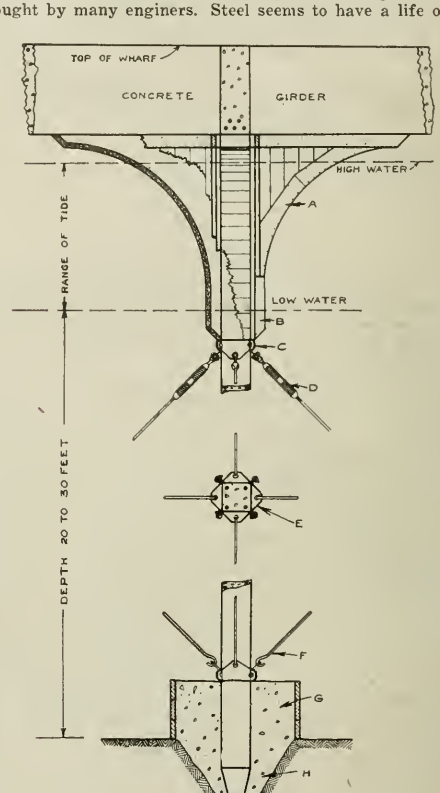
SUGGESTED STANDARD CONCRETE WHARF

By C. R. Coutlee
Department of Public Works, Ottawa, Ont.

THE accompanying drawing is an endeavor to create standard practice with regard to wharf construction in fresh and salt water, and any criticisms of the type shown will be appreciated.

With rock bottom, or with rock only slightly covered with earth, it seems possible to secure the bottom of pile as shown.

The matter of diagonal bracing has been given much thought by many enginers. Steel seems to have a life of 25 years or more if kept always below water level in fresh or sea water. Reinforced concrete also appears to be permanent when always immersed.



TYPICAL CONCRETE PILE WHARF CONSTRUCTION

A—Concrete deposited into and protected by grooved and tongued, creosoted forms, lined with Muntz metal, that remain as part of structure; B—Step-out to ensure that steel reinforcing rods are well covered from salt air; C—Adjustable steel band; D—Steel tie-rod to foot of next pile, with turnbuckle for adjustment; E—Detail of adjustable steel band placed after concrete pile is driven, to which tie-rods are attached; F—Steel tie-rod to top of next pile; G—Concrete deposited in wooden form by pipe from surface, or in bags; H—Rock blasted out to insert foot of concrete pile.

Above low tide, concrete is affected by clinging ice and by salt air. To protect it, grooved and tongued, creosoted covering is suggested. To prevent oil affecting the concrete, the creosoted covering should be lined with sheet copper or Muntz metal or else painted.

If the steel band to which diagonals are attached tends to slip upwards, it is suggested that a canvas bag partially filled with cement be slipped down the pile to rest upon and seat around the steel.

CANADA'S FUEL PROBLEM — SOME NATIONAL AND INTERNATIONAL ASPECTS*

By Arthur V. White
Consulting Engineer, Commission of Conservation

So much has been said, drawn from seemingly authoritative sources, respecting the "unbounded extent of the natural resources of Canada," that it is little wonder the popular view is entertained that Canada's resources are practically unlimited, and perpetual prosperity only waits upon their fuller development. For Canadians, however, to hold and be governed by such a view is to live in a "fool's paradise."

Little more than a decade ago, a large majority of the people of the United States believed that the natural resources of their country were unbounded, and that there was hardly any limit to material progress based upon their development. Even in that country, however, there were many who did not share these views, and through their efforts special investigation was made respecting the actual conditions of the natural resources of the nation.

Natural Resources are Exhaustible

No country possesses, within its own borders, more varied and extensive resources than the United States, yet it is now recognized that many of these are within measureable distance of exhaustion. This fact was so clearly demonstrated that prompt action by the trustees of the nation became imperative. So far as one can judge, natural resources from the 49th parallel to the Gulf of Mexico are better situated, geographically, and must always be more desirable than those from the 49th parallel to the Arctic ocean; thus, by reason of situation, Canada's usable natural resources are, in variety and extent, less than those of the United States.

Those who have observed the rapid disappearance of many of the natural resources of Canada and the present alarming rates at which some are being consumed, realize that the situation, as a whole, is one of great gravity. Consequently, true conservation in Canada is as great, if not a greater necessity than in the United States.

Must Use and Conserve

It is true that some resources, such as minerals—perhaps more especially coal, oil, and gas—if used, must in time, necessarily become exhausted. On the other hand, such resources as the soil, plant growth, waterways and ground waters, may be conserved and transmitted to posterity unimpaired, or at least unabused, just as a good husbandman passes on his farm in an improved condition to that in which he received it. The policies advocated by the Commission of Conservation of Canada have aimed at passing on to succeeding generations in an improved condition the heritage of the natural resources of this country.

By intelligent and thrifty use, the natural resources of Canada may beneficently serve the needs of a large population. If, however, Canadians become really dependent upon necessary commodities supplied them by other countries, they must be prepared to accept the circumstances in which they may suddenly find themselves if the supply of such commodities is cut off. Such circumstances will be aggravated by any abuse of our assets.

Coal Scarcity and Coercion

There is, apart from food, raiment and shelter, perhaps no single commodity which has been found so necessary as fuel—chiefly coal—for the maintenance of life and for the carrying on of commerce and transportation. Recently the public interest has been keenly aroused respecting the nation's fuel supply and increasing dependence upon hydro-electric energy. War conditions have driven home to Canadians as never before the tremendous gravity of their position with respect to fuel.

*From the General Electric Review.

Countries like Norway and Sweden, Denmark, Holland and Switzerland—countries, indeed, which were neutral—were practically dependent upon the warring nations for coal, and found themselves seriously curtailed in obtaining this commodity. They were forced to recognize the momentous fact that the countries which possess coal are able, absolutely, to dictate the terms upon which coal will be supplied to others.

Dependent Upon United States

Now, a very large portion of Canada—and for this one may hold in mind much of the populated territory extending, say, from Quebec to Winnipeg—has become increasingly dependent for its fuel supply upon the coal fields of the United States, and absolutely dependent upon that country for its annual supply of some 4,500,000 tons of anthracite.

In addition to the use of imported anthracite for heating and domestic purposes, large quantities of bituminous coal—some 10,000,000 to 14,000,000 tons—are also imported annually from the United States, largely for power purposes.

The known anthracite fields of the United States are within measurable distance of exhaustion. Doubtless, in the not distant future, the United States will feel compelled so to conserve this valuable commodity that the exportation of it may be largely restricted, if not entirely cut off. There are available many examples, arising out of the great European war conditions, where the United States has found it necessary to place stringent embargoes upon natural and manufactured products.

Now, if Canada is to be in a position to command special consideration under possible restricted trade conditions, she must realize the value of her own resources and have them strictly under national control in order that she may be enabled to deal on a basis of *quid pro quo*. When the commodities of commerce are exchanged there must, of course, be a substantial basis for barter. When Germany demanded gold from Switzerland she offered to exchange coal. Suppose that the United States, in the conduct of her commerce, concluded that it was in the general interest of her citizens only to *barter* coal for certain commodities which she specially required, what desirable commodities has Canada to barter?

Nothing is further from the thought of the writer than to suggest that it is or that it would become the arbitrary desire of the United States to deprive Canada of the coal which at present is so necessary to life in Canada. It is important, however, to take cognizance of the fact that a nation, pressed by the demands of its own people, may be compelled, under certain conditions, to deprive other nations —in part at least—of even the necessaries of life until the needs of its own citizens are met. No country can be expected to send out of its confines that which is essential to the very existence of its own people.

It is not the policy of Canada to embargo her exports. She must, however, conserve against the day of her own need such resources as are available for barter. It certainly is sound policy to insure that commodities of national importance should not be exported without an adequate *quid pro quo*.

Some portions of the United States are as badly in need of coal from Canada as portions of Canada are in need of coal from the United States. Between these two great countries there is an exchange of many natural and manufactured products, and the problems which from time to time arise in connection with such interchange can be satisfactorily solved and the whole situation reduced to a good working basis.

Canada's Water-Power Heritage

Other than the products of her agricultural lands, mines, and forests, there are certain resources in Canada of unique and special value. Canada has an especially rich heritage in her water-powers, including her equity in international waters. To a large extent these water powers are still under the control of the people. This control is being zealously guarded so that as the country develops and sites come into the sphere of active economic importance they may be developed and used in the general public interest. Men

far-sighted in the fields of industry and finance have foreseen the extent to which present and future generations will become increasingly dependent on power, whether it be steam or hydro-electric.

Any estimate for the water powers of Canada must be presented and considered with a due appreciation of its limitations. Table I. representatively sets forth the water-power situation in Canada. By no means may all the water powers be economically developed.

TABLE I.—WATER POWERS OF CANADA
(Tentative Schedule)

Province	Total Estimated 24-hour Low-water Horse Power	Developed Horse Power (a)
Prince Edward Island	3,000	500
Nova Scotia	150,000 (b)	30,000
New Brunswick	300,000 (b)	15,000
Quebec	6,000,000	900,000
Ontario	6,000,000	1,000,000
Manitoba	2,700,000	83,000
Saskatchewan	250,000	5,000
Alberta	450,000	33,000
British Columbia	3,000,000	300,000
Yukon	100,000 (c)	13,000
North West Territories (d)	.....	.....
Total for Canada	18,953,000	2,379,500

(a) This column presents aggregates of installed capacities.
(b) Special investigation now in progress.
(c) A rough estimate made for inclusion in this summary, probably low.
(d) No reliable data available.

Canada has been aggressive in the development and utilization of her water-powers, and no large communities are better supplied with hydro-electric power and light than are places like Montreal, Ottawa, Toronto, Hamilton, Winnipeg, Calgary, Vancouver and Victoria.

The most striking example of hydro-electric energy being developed and distributed on a large scale in order to afford a supply of cheap power and light for communities is found in the work of the Hydro-Electric Power Commission of Ontario.*

This Commission, co-operatively with over 200 Ontario municipalities, has upwards of 3,000 miles of transmission line, and serves over 120,000 customers. In fact, nearly half the population of Ontario is supplied with electricity through the agency of the Commission. The capital investment of the province in connection with these undertakings approximates $55,000,000, in addition to which the various municipalities co-operating with the commission have made an investment of some $20,000,000 in connection with their local distribution and operating systems. This extensive use of electrical energy results in the annual saving of several millions of tons of coal.

Niagara River Power Development

At Niagara Falls, great power development has already taken place. There the capacity of the large power plants in Canada may be stated as in Table II.

Allotted Water all Taken

The total diversion for both countries of 56,000 cubic feet of water per second from the Niagara River as provided by the Boundary Waters' Treaty has now been fully allotted, and before long will all be in actual use by plants on both sides of the river. Suggestions are continually being made to have the treaty revised, so as to permit of greater diversion. One recent proposal is that under a new treaty each country shall be permitted to divert 60,000 cubic feet of water per second, which corresponds to approximately 1,800,000 electrical horse-power, assuming 30 h.p. to be developed per cubic foot of water.

An Exporter of Electricity

About 125,000 h.p. of Niagara hydro-electric power is exported to the United States. Canada is exporting electrical energy from New Brunswick to the state of Maine, from Quebec to New York, from Ontario to New York and to Minnesota, and from British Columbia to Washington. The United States is importing from Canada about 200,000 h.p. years of electrical energy.* Many factors, of course, enter into the determination of the equivalent of this electrical power in terms of anthracite. Speaking in round figures, and taking cognizance of some of these special factors, the electrical power now imported by the United States would be the equivalent of not less than 3,000,000 tons of coal—and doubtless is a quantity substantially greater, even 6,000,000 tons or possibly more, the determination of the equivalent being dependent upon what in any set of circumstances are found to be the governing factors.† It will thus

TABLE II.—NIAGARA POWER PLANTS IN CANADA

Plant	Rated Capacity of Present Installation. Horse Power	Approximate Maximum Generating Capacity. Horse Power
Canadian Niagara Power Co.	112,500	100,000 (a)
Ontario Power Co. (controlled by the Hydro-Electric Power Commission of Ontario)	159,000	162,000 (b)
Electrical Development Co.	135,800	125,000 (c)
Ontario Power Co.'s new pipeline (installed by Hydro-Electric Power Commission), completed 1919	32,000	32,000 (d)
Present total development	439,300	419,000
Chippawa plant under construction by Hydro-Electric Power Commission of Ontario, ultimate development	300,000	300,000 (e)
Total development now provided for	739,000	719,000

(a) At times has generated about 103,000 h.p.
(b) At times has generated about 163,000 h.p.
(c) At times has generated 146,000 h.p., but it is claimed that the water used to generate this amount exceeds the quantity legally usable to generate the 125,000 h.p. specified in the contract.
(d) This pipeline has a nominal capacity to supply water for 50,000 h.p., but the balance of water in excess of that required for the two new 15,000 kv-a. generators is used to increase the efficiency of operation of the older portion of the plant.
(e) To operate under a head of 305 feet and to utilize the descent of the Lower River.

be perceived that, on a power basis, the coal equivalent of the electric energy exported to the United States approximates the quantity of anthracite imported by Canada from the United States.

This electrical energy is, of course, much more profitably employed for power than for heating purposes. In this connection it may briefly be commented, with respect to the restricted possibilities of electric heating, that for years past the author has been emphasizing the comparatively limited use which can be made of electric energy as a wholesale substitute for coal for heating—including the heating of buildings. The sooner it is realized that hydro-electric

*A brief but comprehensive historical survey of the evolution of the Hydro-Electric Power Commission of Ontario, by Arthur V. White, is given in the Commission of Conservation's report, "Water-Powers of Canada," Ottawa, pp. 35-56. For a valuable resume of activities of the Commission, consult, "Electric Power Generation in Ontario on Systems of Hydro-Electric Power Commission," by Arthur H. Hull, in "Proceedings of American Institute of Electrical Engineers," January 1st, 1919; also published in "The Canadian Engineer," issues of December 12th and 19th, 1918.

*For discussion of various aspects of problems respecting the exportation and use of electrical energy, consult the following articles by Arthur V. White: "Exportation of Electricity," which appeared in the "University Magazine," October, 1910, pages 460, et seq. Consult, also "Toronto World," March 18th, 1912; also "Exportation of Electricity—An International Problem; Relation of a Possible Coal Embargo by United States to a Curtailment or Stoppage of Canada's Electric Power," in "The Monetary Times Annual" of January 5th, 1917, pages 21 et seq; also "Coal Problem of Canada Demands National Action—A Solution of a Vital National and International Question" in "The Monetary Times Annual," January 4th, 1918, pages 25 et seq; also consult, "Barter Power for U. S. Coal," in "The Globe," Toronto, November 27th, 1917; and "Monetary Times," Toronto, January 18th, page 9, and February 22nd, 1918, page 26.

†Consult the Hydro-Electric Power Commission of Ontario Report on the "Rate of Coal Consumption in Various Electric Generating Stations and Industrial Establishments in Canada and the United States," by A. S. L. Barnes, Toronto, 1918.

energy can never as a heating agent be an adequate substitute for coal for the citizens of Canada, the sooner will action be concentrated upon sources from which real relief may be derived—there is no use entertaining hope towards a source from which no sufficient relief can come. At the annual meeting of the Commission of Conservation, in November, 1917, the author stated that: "The extent to which electric energy will be available for heating has been much overrated and, realizing the underlying physical limitations one cannot be enthusiastic respecting the extent to which it may be utilized." This statement being made at a time of serious hardship due to power and fuel shortage, attracted widespread attention.*

St. Lawrence River Water-Powers

Outside of the Niagara district the greatest amount of water-power of immediate economic importance is found along the St. Lawrence River. On a conservative basis, the low-water power of the international portion of the St. Lawrence River may be estimated at about 800,000 h.p., of which Canada is entitled to one half, or 400,000 h.p. The correspondingly estimated low-water power on the portion of the river which lies wholly within Canada, is about 1,400,000 h.p., thus making an estimated total for Canada of 1,800,000 low-water continuous h.p. Assuming the diversity load-factor of the present Niagara system of the Hydro-Electric Power Commission of Ontario, Canada's 1,800,000 h.p. on the St. Lawrence would take care of a power demand of some 2,400,000 h.p. The St. Lawrence River power sites are detailed in Table III.†

Coal Resources of Canada

Now, we have seen how great are the water-power resources of Canada, and these, it may be observed, are largely spread over the areas which have no natural coal resources. These areas now importing coal will no doubt be increasingly supplied from the Canadian mines. Considering the country as a whole, Canada in respect of quantity, quality, and accessibility for mining purposes, possesses coal deposits which compare favorably with those of the greatest coal mining countries of the world. Canada, as we have seen, can never depend upon her water powers as a sole source for heat. Consequently, the alternative open to her, and it is this to which special attention is directed, is to develop, and that as rapidly as possible, both her own fuel and power resources, and by co-ordination of transportation and other cognate agencies to provide for the distribution of fuel to all communities in the Dominion. In some respects it is more important to move coal and have it adequately stored and distributed throughout Canada than it is to move the grain out of the country.

TABLE III.—WATER-POWER ON THE ST. LAWRENCE RIVER (Tentative Schedule) (a)

Site	Head Available	Estimated Low-water 24-hr. h.p.	Average Estimated 24-hr. Low-water h.p.
Morrisburg-Rapide Plat	11-15	170,000-230,000	200,000
Long Sault rapid	30-40	500,000-650,000	575,000
Coteau rapid	15-17	230,000-260,000	250,000
Cedars rapid (b)	30-32	490,000-525,000	500,000
Split Rock and Cascades rapids	14-18	220,000-280,000	250,000
Lachine rapid	20-30	300,000-450,000	375,000
Total	....	1,910,000-2,395,000	2,150,000

(a) In this table, to have the estimates fairly representative of the possible quantities which might be expected under representative low-water flow conditions, some allowances have been made for efficiency and other factors.

(b) Under development for about one-third of the low-water flow of the river. Consideration would be given to the possibility of combining the Coteau, Cedars, Split Rock and Cascades; also of increasing the Lachine power.

TABLE IV.—ESTIMATED COAL RESOURCES OF CANADA (a)

Province	Area of Coal Lands Square Miles	Semi-Anthracite Million Tons	Bituminous Million Tons	Sub-Bituminous Million Tons	Lignite Million Tons
Nova Scotia	521		10,691		
N.B.	121		166		
Ontario ...	10				27.5
Manitoba	48				176
Sask.	13,406				65,793
Alberta ...	81,878	845.9	217,918(b)	932,053	29,095
B.C.	6,045		77,923(b)		5,715.5(c)
Yukon	2,840		275(b)		5,159 (c)
N.W.T. ..	300				5,280 (c)
Arctic Is. ..	6,000		6,600		
Total	111,169	845.9	313,573	932,053	111,246

(a) Consult "Coal Fields and Coal Resources of Canada," by Dr. D. B. Dowling, Geological Survey of Canada; also "Coal Situation in Canada," by W. J. Dick, in "Transactions of the Canadian Mining Institute," 1916.

(b) Includes some anthracite coal.

(c) Includes some sub-bituminous coal.

The coal fields of Canada may conveniently be divided into four main divisions:—

1. The bituminous coal fields of Nova Scotia and New Brunswick.
2. The lignites of Manitoba and Saskatchewan, and the lignites, sub-bituminous and anthracite coal fields of Alberta and the Eastern Rocky Mountain region.
3. The semi-anthracite and bituminous fields of Vancouver Island, Queen Charlotte Island, and the interior of British Columbia, and the lignites of Yukon.
4. The low-grade bituminous coal and lignites of the Arctic-Mackenzie basin.

The coal areas and estimated quantities for the different provinces are shown in Table IV. There should, of course, for practical consideration, be a substantial reduction made in these quantities, due to waste in mining operations.

Coal Production and Distribution

Canada annually produces 15,000,000 tons of coal. Her coal and coke production in 1916, 1917 and 1918 are given in Table V. Canada is making special efforts to increase the production of, and areas served by, her coal mines. This is evident from the figures in the table for the province of Alberta, the mines of which, in 1918, increased their production by over 1,200,000 tons. The falling off in production from the Nova Scotia mines is more apparent than real. It is believed that but for the fact that the British Admiralty required, for war purposes, vessels which ordinarily would have been used for transporting coal from the Nova Scotia mines, considerably larger amounts of this coal would have been marketed in territory west of Montreal. No doubt increased quantities of coal will be shipped westward into central Canada through the 14-ft. navigation afforded from the sea to the Great Lakes by the present canal system of Canada.

As a result of the efforts of the Fuel Administration in Canada, there have been assembled considerable data not before available relating to the Canadian coal trade. Some of these data have now been incorporated in a valuable report on the coal trade of Canada. Table VI. from this report summarizes the facts respecting the output, importation and consumption of coal in Canada.*

*For several years past attention has been drawn by Mr. White to the relatively limited use that can efficiently be made of electrical energy as a heating agent. On February 11th, 1918, when addressing the important Fuel Conference held by municipalities in Galt (see "Galt Reporter," Februry 12th, 1918), Mr. White again emphasized his contention that, as a general proposition, electrical energy is more serviceably employed for strictly power purposes, while fuel, such as coal, oil, etc., is more profitably employed for heating. At this meeting he set forth the underlying principles governing in this matter. See "Monetary Times," March 1st, 1918, page 18. Consult, also, "Annual Reports of Commission of Conservation," Ottawa; and article by Mr. White, "Electricity will not Replace Coal," in "Industrial Canada," Toronto, April, 1918.

†From "Power Possibilities on the St. Lawrence River," by Arthur V. White, Ottawa, 1918. See, also, by same author, "Long Sault Rapids, St. Lawrence River, an Enquiry Into the Constitutional and Other Aspects of the Project to Develop Power Therefrom." Commission of Conservation. 384 pp. Ottawa, 1913.

*Consult "Report of the Coal Trade of Canada for the Year Ended March 31st, 1918," issued by the Internal Trade Division, Dominion Bureau of Statistics. 8vo., xiv., 59 pp., Ottawa, 1919.

Canada is making serious effort towards the development on a large scale of her lignite and peat resources; also, towards the increased utilization of her coal fields in the east and in the west. The sum of $400,000 has been made available to the Honorary Advisory Council for Scientific and Industrial Research of the Dominion government for the erection of a carbonized lignite briquetting plant of 30,000 tons of briquettes per annum. Of this sum, $200,000 was voted by the Dominion government and $100,000 each by the provinces of Manitoba and Saskatchewan. Work incident to the construction of the plant is under way. The estimated cost of the briquettes per ton at the mine, including all fixed charges amounting to 20 per cent. on the capital, is $7.*

TABLE V.—COAL PRODUCTION AND DISTRIBUTION IN CANADA

Coal Production in Canada (a)

Province	1916 Short Tons	1917 Short Tons	1918 (b) Short Tons
Nova Scotia	6,912,140	6,327,091	5,852,802
New Brunswick	143,540	189,095	267,746
Saskatchewan	281,300	355,445	345,310
Alberta	4,559,054	4,736,368	5,941,864
British Columbia	2,584,061	2,433,888	2,568,591
Yukon	3,300	4,872	2,900
Total	14,483,395	14,046,759	14,979,213
Distribution of Coal Produced (c)			
Sold for consumption in Canada	10,701,530	10,469,468	11,210,628
Sold for export to U.S.A	1,451,075	1,301,881	1,351,179
Sold for export elsewhere	284,513	301,060	317,135
Total sales	12,437,118	12,072,409	12,878,942
Used by producers in making coke, steel, brick, etc.	804,814	690,573	682,304
Used by producers for colliery operations and by workmen	1,241,463	1,283,777	1,417,967
Total used by producers	2,046,277	1,974,350	2,100,271

(a) Consult "The Production of Coal and Coke in Canada," by John McLeish, B.A., Chief of the Division of Mineral Resources and Statistics, Department of Mines, Ottawa.
(b) Preliminary figures, subject to minor modification.
(c) This is merely a record of distribution by the companies operating the collieries. The figures "Used by producers making coke, steel, brick, etc.," do not represent the total amounts of coal used even in making coke by coke-oven operators.

Peat Resources of Canada

Respecting the peat bogs of Canada, Dr. Eugene Haanel, director of mines, Canada, has strongly urged the necessity of developing our peat resources, and at a recent annual meeting of the Commission of Conservation of Canada, he gave an able, forceful and serious address upon this subject which the people of Canada cannot too carefully consider. Dr. Haanel affirmed the commercial and economic practicability of peat production. Many persons who have had their interest and hope aroused in the prospects of commercial peat, feel that sufficient time has already been available for "experimenting" with peat. They feel that if essential conditions respecting the acquirement of bogs are rightly provided for, and the employment of the best processes of manufacture and handling, costs, etc., are known, the peat industry should by this time have become commercialized the same as other profitable industries. Throughout Canada there have already been discovered areas of peat bog estimated to aggregate 37,000 square miles. According to a broad estimate by Dr. Haanel, and assuming an average depth of bog of six feet, this area corresponds to over 28,000,000,000 tons of peat, having a fuel value equivalent to over 16,000,000,000 tons of good coal. Manitoba, Ontario, Quebec and New Brunswick have peat bog areas aggregating 12,000 square miles.*

The province of Ontario has recently created a Peat Commission, which, it is stated, has two experimental plants in process of construction.

Petroleum Resources in Canada

Canada is known to possess great areas of rich petroleum-bearing shales and sands. Although considerable work has been performed in such areas—as in New Brunswick—nevertheless, the industry cannot really be said to be commercialized. Having in mind the success of the oil shale industry in Scotland, there appears little doubt but the corresponding industry in New Brunswick, Nova Scotia and elsewhere, will ere long become extensive.

TABLE VI.—COAL OUTPUT, IMPORTATION AND CONSUMPTION OF COAL IN CANADA

	1915	1916	1917
West of Head of Great Lakes:			
Output B.C.	2,208,289	2,783,849	2,676,760
Output Alta., anthracite	125,732	140,544	118,717
Output Alta., bituminous	1,626,237	2,335,259	2,206,868
Output Alta., lignite	1,682,922	2,172,801	2,537,829
Output Sask., lignite	243,125	294,264	360,623
Imported from U.S.A., anthracite	298,895	533,846	514,688
Imported from U.S.A., bituminous	1,423,882	2,550,352	2,825,702
Total tonnage made available	7,609,082	10,810,915	11,241,187
Exported	864,160	1,105,718	1,029,532
Net consumption	6,744,922	9,705,197	10,211,655
East of Head of Great Lakes:			
Output Nova Scotia	7,513,739	6,911,995	6,345,335
Output New Brunswick	126,923	143,658	189,668
Imported from U.S.A., anthracite	3,773,135	4,040,368	4,805,000
Imported from U.S.A., bituminous	7,622,449	10,739,478	14,394,122
Total tonnage made available	19,036,246	21,835,499	25,734,125
Exported	902,383	1,029,641	703,824
Net consumption	18,133,863	20,805,858	25,030,501
Total consumption in Canada	24,878,785	30,511,055	35,242,156

According to all indications, the year 1919 will see the greatest prospecting propaganda for oil that has occurred in Canada. Many interests—Canadian, British and United States—are arranging for prospecting parties with modern equipment and oil experts to prospect, especially in Alberta and British Columbia.

Respecting the possibility that petroleum will be discovered, particularly in the Viking area and the Peace and Athabaska valleys, "the situation may be summed up as very promising," states Mr. James White in his recent monograph on the "Fuels of Western Canada."†

He states further:—

"A small quantity of dark oil obtained in one of the wells in the Viking gas field is an encouraging indication, and oil has also been found in the Pelican Rapids gas well. Seepages of oil have been found near Waterton Lake, in

*Consult "The Briquetting of Lignites," by R. A. Ross, Report No. 1, Honorary Advisory Council for Scientific and Industrial Research, Ottawa, 1918. Consult, also, "Carbonizing and Briquetting of Lignites," by W. J. Dick, Commission of Conservation, Ottawa, 1917; also by same author, "Canada's Own Coal and the Fuel Problem," in "Industrial Canada," April, 1918; also "Fuels of Western Canada and Their Efficient Utilization" (revised edition), by James White, Commission of Conservation, Ottawa, 1918.

*Consult "Peat as a Source of Fuel," by Eugene Haanel, Director Mines Branch, Ottawa, 1918.
†See note under Lignites, "Supra."

(Continued on page 151)

POINTS REQUIRING SPECIAL OBSERVATION AND INVESTIGATION IN BRIDGE INSPECTION*

By Herbert C. Keith

THE old proverb that a chain is no stronger than its weakest link seems sometimes to be contradicted by a bridge truss, which may be stronger than its weakest member appears to be, as judged by the ordinary methods. Professor Vose used to say that there are many bridges that are kept from falling "only by the grace of God and the force of habit." There are certainly many which depend upon some means of transmission of loads to the abutments that no self-respecting engineer would rely upon in designing, though recognizing and taking advantage of it sometimes in a critical investigation of an existing bridge. For instance, a rapidly moving electric car may skate safely across a short span or a single panel which would be unsafe for the same car even to stand on. Another example is found in the fact that a bridge may be safe for a car electrically driven when it would be unsafe for a steam locomotive of the same weight, on account of the difference in the mode of transmission of the power to the driving wheels, rotary in the one case and reciprocal in the other. These are cases which show a reduction of strain on stringers often greater than would be the increase of strain due to the sudden application of a load. Track rails (and jack stringers when used) add materially to the carrying power of stringers of short spans, especially if the rails are heavy. Guard rails and even guard timbers and the stiffness of the car itself give some help; also the continuity of the stringers of a truss bridge when the stringers are framed into the floorbeams and riveted to them. The stiffness of truss chords may make the strength decidedly greater than would be determined by considering each intersection as if it were a joint with a fractionless pin, instead of a continuous riveted box girder, as may be the case.

Rivets and Pins

A very marked instance of greater strength than is assumed in the ordinary methods of calculation is the case of rivets and pins. A large factor (indeed probably the main factor) in the real strength of a riveted joint is the friction of the members upon each other under the pressure of the gripping of the rivet. W. J. Watson, in a paper presented to the American Society of Civil Engineers in 1906, assigns to this friction a value of 14,000 lbs. per sq. in. of cross section of rivet for one plane of contact (or when acting in single shear) and 18,000 lbs. per sq. in. for two planes of contact (or in double shear). The present author would hesitate to give definite mathematical value to this friction, since probably no two rivets exert the same pressure. But it is axiomatic that this friction is great only while the rivet is tight; as soon as the rivet becomes loose it is an entirely different story. This value of a riveted joint is so great and so evident that account of it is taken in the author's modifications of the specifications of the Massachusetts Public Service Commission. In calculating pins it is customary to assume that the pressure of each member upon the pin is concentrated at the centre line of its bearing surface, whereas the fact is that, before a pin would fail by bending, the pressure of each member would become concentrated at that edge of the member which would give the minimum bending moment. This makes the real bending moment on most pins only a small fraction of that obtained by using the ordinary assumptions. An examination made by sawing through the line of flange rivets of an iron floorbeam removed nearly 30 years ago showed the rivets in exceptionally good condition, though by the accepted method of calculation they had been subject to 80,000 lbs. per sq. in. in shear and 130,000 lbs. per sq. in. in bending. In the same bridge, pins which were figured to have a moment of 300,000 lbs. per sq. in. bending, were found to show no slightest sign of overstrain.

*From a paper presented before the Brooklyn Engineers' Club.

Another matter, the importance of which is often greatly overestimated, is the secondary stresses due to large gusset plates at joints of riveted trusses. In most cases where youthful engineers speak with awe of the "terrible secondary stresses," they overlook the added value given to the members by stiffening them through the length of these gussets, thereby reducing the unsupported length of the members, and also giving them "fixed ends." This remark should not be understood to give approval to eccentric connections, for these should always be avoided if practicable, and the eccentricity reduced to a minimum when it cannot be altogether avoided; it is simply intended to call attention to a side of the question which is sometimes overlooked. If one were to judge by the school of specialists on the "secondary stress" bugaboo, pin-connected trusses would be the ideal construction for all bridges, long or short; whereas the greater rigidity or stiffness of riveted trusses makes them far more durable, especially for moderate and short spans; while plate girders, for a similar reason, are still better for lengths for which their use is practicable.

Reduction of Vibration

The importance of rigidity and reduction of vibration, not only in prolonging the life of a bridge but also in increasing its strength when new, can hardly be overestimated. Its advantage in increasing the confidence of the public is also real and important. Time was when some engineers delighted in pointing out the "spidery" structures of their designing, with pride that they could perform such marvels. The cost, or amount of material used in such cases may have exceeded what would have sufficed for a structure that would appear, and really be, much more substantial.

Effect of Track Position

The capacity of a bridge for track loads is far more affected by the position of the track than is generally appreciated. It is frequently found that a track which, according to the plans, should be centered with the bridge is considerably off centre. As an illustration of the effect of this "eccentricity," take the case of stringers 5 ft. on centres, and the centre of the track 1 in. to one side of the centre of stringers; this causes a strain on the nearer stringer 3⅓ per cent. greater than if the track were on centre. The eccentricity of a track is likely to change from time to time, especially on a curve and particularly near its ends. Because of possible changes in the eccentricity, it is the practice of the author, in making up the figures for moment and shear, for inspection reports, to make them first as if the track were on centre and to make a separate item for the excess due to eccentricity of more than about ½ in.

Shear Due to Sidewalks

An overhanging sidewalk, similarly, adds more than its weight and that of its load to the strain in the nearer truss. Reduction of moments in floorbeams by such overhanging sidewalks is disregarded in the author's calculations, on account of the possible temporary removal of the sidewalk. But the increase in shear due to such sidewalk is given its due importance.

Roadway and Sidewalk Loads

Sometimes engineers are known to argue that no impact allowance need be made with roadway and sidewalk loads, though it seems strange that anyone should hold this opinion. The specified 100 lbs. per square foot is no doubt sufficient to provide for as large a crowd on a sidewalk as can move with such speed and harmony as to exert the additional force ordinarily included in the term "impact," unless the gathered crowd is expected to "cheer with its feet." But even for sidewalk loads there is a possibility of a greater weight than the sum of the specified weight and the specified impact. Prof. L. J. Johnson, in experiments made in 1904, obtained a weight of 181 lbs. per square foot. In reporting the experiments to the Boston Society of Civil Engineers, Prof. Johnson says: "Though 181 lbs. per square foot must be conceded to be an extreme, it is believed that something very close to that figure is reached, over the whole drawbridge on the way from Soldiers' Field to Harvard Square

after one of the great football games"; and he adds: "The conclusion seems irresistible that loads of 180 lbs. per square foot may actually occur in exceptional cases; that 160 lbs. must frequently occur; that 140 lbs. must be common on station platforms, in corridors and in many other places frequented by throngs of people." In the present day of rapid giant automobile trucks, the case for roadway loads is different. One such motor truck for which data are available has a weight of 17 tons on an over all area of 140 sq. ft., or 243 lbs. per square foot, when carrying no more load than its rated capacity. As there is no inspector at the junction points of highways, it is altogether probable that the overload on such trucks is not kept down to the 10 per cent. common with freight cars, and the actual load may be expected to run up sometimes to 300 lbs. per square foot of the space occupied when the truck is at rest. (Trucks with much greater weights per square foot than this are operated in this city, but they are reported as never used on bridges.) Of course, the whole roadway of a bridge would not be covered with such trucks in close contact both longitudinally and transversely; and if they were so placed, they would not be able to operate at speed. But such loads covering a third of the roadway area would be quite possible and might run at moderate speed. That the specified allowance for impact is none too large for such loads, any observing man will admit after seeing and hearing such trucks run across a bridge with a plank floor, or one on which even small pebbles are found.

Errors of Erection

If errors in erection have been found, so that members are transposed or misplaced on the pins, or if a test with the hammer indicates uneven distribution of stress between the pairs or sets of tension members intended to work together, due attention must be given to these facts in determining the capacity of the bridge.

Composite Stringers

Composite stringers, as two or more timbers or beams of different depth, or flitched beams with timber between I-beams or channels, present two possible conditions to the investigator. If the component parts are constrained to equal deflection, the load is considered as distributed in the way which would cause such equal deflection, in which case the capacity of the combination is less than the sum of capacities of the components. If unequal deflections may take place, the distribution of the load is determined by the theory of least work, or so as to produce equal unit stresses in the extreme fibers, if of similar material, or proper relative stresses if of unlike material.

Safety of Derailed Cars

Any type of construction which makes no provision for the safety of a derailed car is very undesirable. One such which seems to be popular is a flitched beam with the rail spiked directly to the timber stringer, which is bolted between two I-beams or channels, with no floor between the stringers at all adequate to support a car if it leaves the rail. Another similar construction is a double stringer of I-beams or channels with spiking pieces between, which rest on horizontal separators of short pieces of channel riveted to the beams. Fortunately, many bridges with such stringers have heavy plank floors laid on top of the stringers, so providing for the safe passage of a derailed car if it does not get too far away from the track stringers. A danger in many highway bridges is that a car may leave the rails and the support provided for it and get on to that part of the bridge where the stringers were designed for lighter loads; perhaps also nearer the centre of floorbeams competent to carry a car only near one end.

Investigation of Compression Members

Compression members should sometimes be investigated on three different bases, each with its proper length and radius of gyration:—

(a) In the plane of the truss.

(b) In the plane of the members, perpendicular to the plane of the truss.

(c) In a plane normal to the least radius of gyration of the member or of one of its components.

In case (a) the effective length may be taken as the distance between centres of connections (or sometimes less) instead of the distance between the theoretical panel points.

Pony trusses without proper side support for the top chords call for careful consideration as to what should be taken as the unsupported length of such chords. No general rule for such cases can be laid down, but each must be considered on its own merits, according to the specific conditions.

Riveted Connections

The value of a rivet whose grip is more than four diameters is decreased about 1 per cent. for each 1/16 in. of this excess. Attention may here be called to the fact that the diameter of a rivet which fills the hole is 1/16 in. greater than its diameter before driving.

Rivets in reamed holes, if equally well driven, are worth much more than in punched holes for several reasons:—

(a) Because in the reamed hole the rivet upsets more readily to completely fill the hole;

(b) Because it has its full section for its full length without a possibility of offset or shoulder;

(c) Because, on account of both facts just mentioned, the rivet also exerts greater pressure on the parts riveted together, increasing the friction between the surfaces in contact;

(d) Because whatever burr is formed in reaming the hole adds to the friction between the parts.

The rivets of top flanges of deck girders and stringers, especially in very old bridges, are sometimes found to be insufficient for local loadings.

In riveted connections the spacing is often so close as to leave insufficient metal between to develop the rivets. If this is found to be the case the value of the net section is used, rather than the rivet value, in determining the value of the detail. The same trouble is often found near the ends of a girder, where the desire to save 1/16 in. in the thickness of the web leads the careless or ignorant designer to crowd the rivets unduly. This reduction of thickness of web is in other ways not always real economy, as it may necessitate additional stiffeners costing more than is saved in the web.

Floorbeams

End floorbeams of swing bridges or of fixed spans adjacent to such bridges are often found to be lighter than the intermediate floorbeams, through a mistaken notion that the loads for these floorbeams are only half as great. As a matter of fact, the actual live load is usually much larger (often double or even more), and even the dead load is sometimes greater than on the intermediate floorbeams, for the overhang of the floor gives not only an extra loaded length, but also a leverage which makes the force acting on the floorbeam greater than the weight of the load itself. In addition to the direct loads, the extra impact due to the open space between the fixed and movable spans adds greatly to the effect of the live load, which is still further increased by a possible difference in level of the floors of the two spans.

Pedestals and Rockers

Often pedestals for truss bridges, and sometimes rockers for long plate girders, are found to be too short to provide fully for longitudinal thrust or webs are too thin to support their loads and resist transverse shocks without stiffening diaphragms. In a similar way pin plates on compression members of pin trusses, or joint gussets of riveted trusses, are frequently found to be too thin to give a radius of gyration for the unsupported length of jaws comparable to the radius of gyration of the member as a whole for the whole length of the member.

Loop Hangers

Loop hangers for floorbeams are frequently found to be deficient in the details. Loop hangers of liberal size may bear upon clip angles which have insufficient strength, either in themselves or by stiffeners bearing upon them, to prevent

bending up from the weight which they have to carry. Sometimes insufficient rivets are used in connecting such clip angles to the floorbeams. Even when a loop hanger passes down through or around both flanges of a floorbeam and takes bearing on the bottom flange angles, if there is no tie plate or only a thin loose washer plate, these angles and washers are very often found to be insufficient.

Decay of Timber Stringers

The reduction of the strength of timber stringers due to decay is not always appreciated. That the unit stresses generally allowed for timber leave a larger factor of safety above the elastic limit than is commonly left in the case of steel members is realized. This is wise, because wood exposed as is usual on bridges, deteriorates more rapidly than steel or iron which receives reasonable care. But, regardless of the reduction of strength of individual fibers which, though not so far gone as to be called rotten, are approaching that stage, a slight loss of section in the top or bottom of a stringer reduces the strength for resistance to bending altogether out of proportion to the amount of section lost. In a timber beam 12 in. deep a loss of 1 in. in depth reduces the section 8 per cent. and the strength 16 per cent.; 2 ins. in depth reduces the section 17 per cent. and the strength 30 per cent.; 3 ins. in depth reduces the section 25 per cent. and the strength 44 per cent.; 4 ins. in depth reduces the section 33 per cent. and the strength 55 per cent.

If the decay is uneven the loss of strength is even more striking. A 12-in. stringer having full depth at one side and reduced at the other side 2 ins. has its section reduced 8 per cent. and the strength reduced 28 per cent.; 4 ins. has its section reduced 17 per cent. and the strength reduced 46 per cent.; 6 ins. has its section reduced 25 per cent. and the strength reduced 58 per cent.; 8 ins. has its section reduced 33 per cent. and the strength reduced 66 per cent.

Sound timber, notched for pipes or other obstructions, would be reduced by these ratios; but in considering decayed timber it must be remembered that there is not a sharp dividing line between sound and rotton wood. Hence it is not wise to increase the allowed unit stress in timber for the consideration of existing structures above the amounts given in the specifications, particularly as decay in timber is wont to proceed rapidly when once started. Oak, chestnut, ash, and to a less degree, spruce timber, may lose a great part of their original strength while still showing little change in their appearance.

Corrosion and Bolt Holes

Corrosion and bolt holes in flanges of rolled steel beams reduce the strength far more than is generally realized. Of course the fact is known when thought of, but it is too commonly overlooked. The following figures illustrate these cases:—

If a 12-in.-31½-in. I-beam used as a stringer has 1 hole ⅞ in. in diameter in one flange, the strength is reduced 12¼ per cent.; 1 hole ⅞ in. in diameter in each flange, the strength is reduced 14¼ per cent.; 2 holes ⅞ in. in diameter in one flange, the strength is reduced 24½ per cent.; 2 holes ⅞ in. in diameter in each flange, the strength is reduced 28½ per cent.; ⅛ in. thickness rusted from one flange, the strength is reduced 15¼ per cent.; ⅛ in. thickness rusted from each flange, the strength is reduced 19 per cent.

If a 12-in.-20½-in.-lb. channel used as a stringer has 1 hole ⅞ in. in diameter in one flange, the strength is reduced 17¾ per cent.; 1 hole ⅞ in. in diameter in each flange, the strength is reduced 21½ per cent.; ⅛ in. thickness rusted from one flange, the strength is reduced 15 per cent.; ⅛ in. thickness rusted from each flange, the strength is reduced 18¾ per cent.

Spacing of Ties

Ties should be spaced not more than 8 ins. apart in the clear (6 ins. is better), or a derailed car wheel will drop so low between the ties as to cause too great pounding. They should be notched not less than ¾ in. for the stringers and attached to them by hook-bolts or some suitable substitute at every third tie. There should be not less than 6 ins. thickness of timber above the dapping. For wide spacing of girders or stringers, or when one rail is elevated while the stringers are at the same level, deeper ties may be required.

Guard Rails

Inside guard rails are a very important adjunct to a bridge carrying a track, to prevent the wandering of a derailed car; such guard rails should be fully spliced or their efficiency will be greatly reduced. Care should be taken that bolts are so placed that neither heads nor nuts can be sheared off by a derailed car. Some engineers do not realize that outside guard timbers do not answer the same purpose; and the requirements of at least one Railroad Commission until recently called for lining angles on these timbers, apparently with this misunderstanding. A brief consideration of this subject will show the fallacy of this view; if a wheel is retarded by rubbing against the inside rail, it will tend to turn the axle a little, directing the car toward its normal location; but the retarding of a wheel by rubbing on the outside guard timber will swing it further out of line and away from its proper place. This change of direction, too, will throw it against the guard more nearly at right angles, thus making it more likely to climb the guard and leap into whatever disaster is lurking beyond.

Though the outside guard timbers are not qualified for guiding a derailed car, they do have a very important office. Without them or some substitute, the ties would be likely to become bunched; the guard timbers also help to distribute the load and reduce the danger that the ties will tip up under a derailed wheel when stringers are too closely spaced. Guard timbers should always be notched over the ties and should be bolted to at least every fourth tie. Splices should have a horizontal lap joint.

PUBLICATIONS RECEIVED

IRVING SUBWAY.—Pocket-size catalogue (No. 2-A), issued by the Irving Iron Works Co., Long Island City, New York, illustrating and describing the "Irving Subway," a fireproof, ventilating flooring for power houses, industrial plants, etc.

PUBLIC WORKS REPORT.—Report of the Minister of Public Works for the Province of Ontario for the twelve months ended October 31st, 1918; 100 pages and paper cover; 6½ by 9½ ins. Contains the reports of A. J. Halford, Engineer of Public Works; C. H. Fullerton, Superintendent of Colonization Roads; and F. R. Heakes, Provincial Architect.

EMPIRE MUNICIPAL DIRECTORY AND YEAR-BOOK.—Published by the Sanitary Publishing Co., Ltd., 8 Breams Bldgs., London, E.C., England. This directory is in its 37th year of publication. It consists of lists of local authorities and officials in the United Kingdom and all of the British dominions and colonies; 272 pages and cover, 7 by 9½ ins., cloth bound; price, $1.50 postpaid to Canada.

CERTAIN LINES IN ONTARIO AND QUEBEC.—By F. B. Reid, supervisor of levelling, Geodetic Survey of Canada. Published as Publication No. 4 of the Geodetic Survey. This pamphlet describes bench marks from Montreal to Hull, P.Q.; St. Martin Junction to Three Rivers, P.Q.; Grenville, P.Q., to Prescott, Ont.; Ivanhoe to Toronto, Ont.; Bethany to Port Hope, Ont.; Myrtle to Whitby, Ont.; North Toronto to Mimico, Ont. It also includes an index and map showing all work previously published.

THE JEFFREY CARRIER.—Cloth-bound book, 96 pages and cover, 6 by 9¼ ins., distributed gratuitously by the Jeffrey Manufacturing Co., Montreal, P.Q., and Columbus, Ohio; published in three colors on coated paper, profusely illustrated. This booklet describes the pivoted bucket conveyer and is published as catalogue No. 210. It is so full of useful data concerning carriers, has so many illustrations of various installations, and is so well printed and substantially bound, that it will prove a desirable addition to the engineer's library.

ECONOMICAL SIZE OF PIPE FOR GIVEN LOSS OF HEAD*

By Prof. E. W. Rettger
Cornell University

THE most economical size of penstock is a matter of the greatest importance when the penstock is a long pipe under high head. In such a case the first cost of the penstock is apt to be the largest part of the total first cost of the plant and it is therefore very important that the most economical size of the penstock be determined.

Before the most economical size of penstock can be determined, it is necessary to know what principal of economy is to be used. This principal may be different for different plants. For instance, it may be required to determine the size of the pipe so that the total net annual income shall be a maximum, or so that the percentage return on the original investment shall be a maximum. In other cases it may be required to determine the pipe so that the percentage return on the original investment shall be a specified amount. This may be the case when the amount of water available is limited and when it is imperative to produce as much power as possible, consistent with a fair rate of return on the original investment. Thus, the economic design of a penstock may come up in a variety of forms.

When the penstock is to consist of a pipe of constant diameter throughout, the problem, so far as the penstock is concerned, is comparatively simple. Assume, for instance, that the net annual income shall be a maximum. A simple and direct method of procedure in determining the economical size of pipe of constant diameter throughout, under the given principle of economy, is as follows:—

Calculate or approximate the total net annual income for each of several assumed diameters. With the diameters as abscissae and the total net annual income as ordinates, a curve may be plotted. From this curve, the diameter can be found for which the total net annual income will be a maximum.

In the case of high heads, however, it is often found economical to make the pipe consist of two or more sections of different diameters. Such a pipe would approximate the shape of a funnel with the smallest diameter where the head is the highest. In other cases it is found economical to make the upper part—the part under the low head—consist of concrete or staves and the remainder of steel. The determination of the economical pipe now reduces to the determination of the diameters of the several sections and the problem may not be an easy one. The method of procedure suggested for the case of a pipe of constant diameter throughout, is no longer applicable. While considerable latitude is left to the designer, it is nevertheless important to be able to determine what the theoretically economical diameters of the several sections are.

In 1907, A. L. Adams proposed a principle for the design of a penstock that seemed to him self-evident. This principle may be stated as follows:—

That pipe is most economically designed for which the interest and depreciation on first cost of the pipe plus the annual value of the power lost due to friction in the pipe is a minimum.

This principle of economy seems simple and logical and it is referred to in nearly every discussion on the economical size of penstock. Frequently, formulas for the economical diameter are derived from it. For the case of riveted steel, Professor D. W. Mead (Mead's Water Power Engineering, 2d edition, page 546) derives two formulas:—

$$(1)\quad d=0.2153\sqrt[7]{\frac{fbq^3S}{cih}} \text{ for high head}$$

and

$$(2)\quad d=0.2195\sqrt[6]{\frac{fbq^3}{t'ci}} \text{ for low head}$$

where h is the head on the point under consideration; f is the coefficient of friction defined in equation (3) which follows; S is the allowable unit stress in shell in pounds per square inch corrected for rivet holes and water hammer; c is the cost of the metal per pound; i is the rate of interest and depreciation on first cost of pipe; b is the annual value of a horsepower at the wheel; and q is the discharge in cubic feet per second.

When the required theoretical thickness of the shell is more than the minimum allowable thickness, the pipe is considered to be designed for high head and formula (1) applies. When the theoretical thickness of the shell becomes less than the minimum allowable thickness, formula (2) applies, which was derived on the asumption that the thickness of the shell shall be the minimum allowable thickness, t'.

From formula (1) it is seen that the theoretically economical diameter of a pipe under high head decreases as the head h, increases; and from (2) it is seen that the economical diameter for a pipe under low head is independent of h.

In deriving formulas (1) and (2) the friction head was assumed to be given by

$$(3)\quad h'=\frac{fl}{d}\cdot\frac{v^2}{2g}.$$

Now f is unknown to start with since it depends upon the diameter of the pipe which is not yet determined. In practice, a value of f is first assumed, and the diameters of the pipe are determined by means of the above formulas. If the average value of f for the pipe so determined differs appreciably from that assumed, a revised value for f is taken.

If the friction head for riveted steel pipes is assumed to be given by the formula

$$(4)\quad h=0.00050\ \frac{v^2\,l}{d^{1.25}}\ ;$$

the resulting formulas become:

$$(5)\quad d=0.1423\sqrt[7.25]{\frac{bq^3S}{cih}} \text{ for high head;}$$

and

$$(6)\quad d=0.1356\sqrt[6.25]{\frac{bq^3}{t'ci}} \text{ for low head.}$$

Formulas (5) and (6) do not contain the unknown coefficient f. So far as the writer knows, formulas (5) and (6) are here given for the first time.

If the value of b, the value of a hydraulic horsepower at the wheel, is given, Adams' principle and the resulting formulas will solve the problem. Unfortunately the proper value for b is not always known. As already stated the principle of economy to be used in the design of a penstock may be one of several, and Adams' principle may be difficult to apply. Engineers of experience declare that this principle is not always applicable. These considerations urged the writer to see if a method of attack analogous to that suggested for a pipe of constant diameter throughout could be used, and as a result he has arrived at certain conclusions that may be of interest to students of hydraulics.

If for an assumed total loss of head h', the most economical pipe could be found, the following method would be applicable: For each of several assumed values for the total loss of head, h', in the pipe, determine the economical pipe, and if, the total percentage return, p, is to be a specified amount, calculate or approximate the *percentage return* for each assumed value of h'. A curve can then be drawn with h' as the abscissa and p as the ordinate. From this curve the value of h' can be obtained so that the percentage return shall be the desired amount. Now with h' determined, the most economical pipe can be found.

If the pipe is homogeneous—made entirely of riveted steel for instance—the pipe of least annual cost will be the pipe of least first cost, or of least amount of metal. If the pipe is not homogeneous, such as when the upper part is of staves and the lower part of steel, it is no longer a question of least amount of metal but rather one of least first cost or least annual cost. As shown later, the expression that will determine the diameter of the pipe for least annual cost will also determine the pipe for least first cost or least amount of metal (pipe homogeneous) if one or two of the

*From the "Cornell Civil Engineer."

constants involved are made equal to unity. It will be convenient therefore, to consider the case of least annual cost. The problem may be stated as follows:—

Given a pipe of fixed length, l, and under a given head, h, with a given discharge, q, it is required to find the size of the pipe so that for a given or assumed total loss of head, h', in the pipe the annual cost of the pipe will be a minimum.

The problem as thus stated is of considerable interest. In the "Engineering Record" of December 20th, 1913, page 682, E. R. Bowen describes the inverted Jawbone Syphon of the Los Angeles aqueduct. This inverted syphon was to be designed to contain the least amount of metal subject to the condition that the loss of head due to friction in the syphon should be 26 feet. The solution as given by Mr. Bowen is a graphical one requiring a great deal of labor. This same problem could have been solved in a much simpler way.

The annual cost of the pipe is the interest and depreciation on first cost and this will be represented by I. The The problem then is to find the size of the pipe so that I will be minimum, subject to the condition that the total loss of head in the pipe shall equal h'.

In practice, the pipe is made to consist of two or more sections, each section of constant diameter and thickness of shell. The greater number of sections, the more nearly will this pipe approach the theoretically most economical pipe, one in which the diameter decreases as the head increases.

For the sake of convenience we will assume that the pipe is to consist of three sections as shown in Figure I.

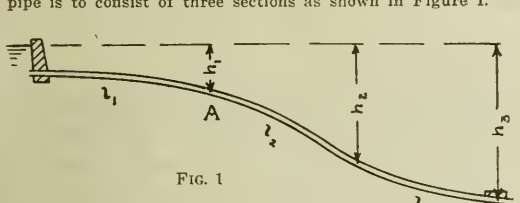


FIG. 1

Let l_1, h_1, d_1; l_2, h_2, d_2 and l_3, h_3, d_3 be the lengths, heads and diameters of the respective sections.

Evidently, the location of the points of division a and b will effect the economy. It can be shown that the location of the most economical points of division depends upon the profile. These points, perhaps, can best be found by trial. For our purpose it is necessary to assume that the points of division are given. Consequently h_1 and l_1, h_2 and l_2, h_3 and l_3 are assumed as given or determinate.

The interest and depreciation on first cost of a section is proportional to the amount of metal in that section. Using a well known principle of hydraulics, the amount of metal in that section under high head is found to be proportional to $d_r^2\, h_r\, l_r$. The subscript r is used to indicate that it applies to a section and not to the pipe as a whole. The annual cost (interest and depreciation) of this section may therefore be represented by the equation

(7) $I_r = A d_r^2 h_r l_r$;

where A is a constant. Moreover, the friction head for this section may be expressed by (see eq. 3)

$$h'_r = \frac{f l_r}{d_r} \cdot \frac{v_r^2}{2g}$$

or, if v is eliminated by means of the relation $F_r\, v_r = \frac{1}{4}\pi d_r^2\, v_r = q$, by

(8) $h'_r = \frac{C l_r}{d_r^5}$;

where C is a constant. The problem then requires us to find d_1, d_2, and d_3 so that

(9) $I = I_1 + I_2 + I_3 = A\ (d_1^2 h_1 l_1 + d_2^2 h_2 l_2 + d_3^2 h_3 l_3)$

will be a minimum subject to the condition that

(10) $h' = h'_1 + h'_2 + h'_3 = C\left(\frac{l_1}{d_1^5} + \frac{l_2}{d_2^5} + \frac{l_3}{d_3^5}\right)$

shall have a specified value. If, now λ is a constant, the expression,

(11) $L = I + \lambda h'$,

will be a minimum when I is a minimum. Since h' shall have a definite value, it may be considered a constant. Substituting the values of I and h' as given by equations (9) and (10) and rearranging, equation (11) becomes

(12) $L = (I_1 + \lambda h'_1) + (I_2 + \lambda h'_2) + (I_3 + \lambda h'_3) = L_1 + L_2 + L_3$

For an assumed mode of division of the pipe into sections, h_r and l_r are given for each section and therefore must be considered as constants. Consequently L_1 contains d_1 as the first variable. Similarly, L_2 contains d_2 as a second variable and L_3 contains d_3 as the third variable. L_1, L_2, and L_3 contain no variable in common and they are therefore independent functions. From this it follows that if their sum must be a minimum, each separately must be a minimum. That is, we must have separately

(13) $\frac{d L_1}{d (d_1)} = 0 \qquad \frac{d L_2}{d (d_2)} = 0 \qquad \text{and} \quad \frac{d L_3}{d (d_3)} = 0.$

Or in general [see eq. (11)],

(14) $\frac{d L_r}{d (d_r)} = \frac{d I_r}{d (d_r)} + \lambda \frac{d h'_r}{d (d_r)} = 0$

for each section of the pipe.

Since λ is a constant, yet to be determined, we may arbitrarily let

(15) $\lambda = \frac{b\, q}{8.8}$

and consider b the constant yet to be determined. Substituting in equation (14), we obtain

(16) $\frac{d L_r}{d (d_r)} = \frac{d I_r}{d (d_r)} + \frac{b\, q}{8.8} \cdot \frac{d h'_r}{d (d_r)} = 0$

for each section of the pipe.

From equations (7) and (8), it is seen that l_r is a factor of equation (16). Dividing through by l_r and performing the differentiation indicated, the resulting equation becomes identical with that derived by Prof. Mead (Water Power Engineering, page 546). Formula (1) therefore, gives us the required diameter for any section under high head and formula (2) for low head. The value of h to be used in formula (1) when applied to any section should be of course the highest head that section is under.

In the present interpretation of formulas (1) and (2), b is not to be considered as the value of a hydraulic horsepower at the wheel, but as a constant or parameter such that the total loss of head in the pipe shall be h'. Although a constant, b is not arbitrary, but its value must be determined. This can be done in the following way: For riveted steel pipes, the diameters as determined by formulas (1) and (2) must satisfy the equation [see equation (10)]

(17) $h' = C\left[\frac{l_1}{d_1^5} + \frac{l_2}{d_2^5} + \frac{l_3}{d_3^5} + \ \ldots\ \right]$

If, therefore, the values of d_1, d_2 and d_3 as given by formulas (1) and (2) be substituted in equation (17), the resulting equation will contain b as the only unknown, and therefore b is determined. If, for instance, the first section is under low head and the other two under high head, d_1 is given by formula (2) and d_2 and d_3 by formula (1).

Instead of determining b algebraically as was suggested above, a value for b may be assumed and the diameters determined by means of the formulas. A few trials will suffice to determine b so that the total loss of head in the pipe line will be h'.

Since for a given mode of division of the pipe line into sections, h' is determined as soon as a value for b is assumed, the formulas (1) and (2) may be given a new interpretation. According to this interpretation b may be taken as a parameter such that for every assumed value for b, the resulting pipe line will, for the resulting total loss of head in the pipe, be the pipe of least annual cost (or least first cost or least amount of metal). This interpretation, so far as the writer knows, is here given for the first time.

In special cases b may be taken as the value of a hydraulic horsepower at the wheel. The new interpretation, however, still holds since the pipe as thus determined

will be the most economical pipe for a particular loss of head. The new interpretation of formulas (1) and (2) (and all other formulas of the same nature) is therefore the general interpretation, and these formulas as an expression of Adams' Rule become a special case.

The economical size of a penstock or pipe may now be determined in a manner analogous to that suggested for pipes of constant diameter throughout. If, for instance, the percentage return on the original investment shall be a specified amount, we may proceed as follows:—

For each of several assumed values for b determine the pipe and calculate or approximate the percentage return p. With b as abscissa and p as ordinate a curve may be drawn. From this curve that value for b may be obtained for which the percentage return is the specified amount.

Illustrative Problem

A hydro-electric plant is to be designed so that the gross percentage return on original investment shall be a specified amount. The pipe is to be riveted steel. Besides the data given in the figure, let $q=50$ cu. ft. per sec.

$S=10{,}000$ lbs. per sq. in.
$t'=\frac{1}{4}$ in. as a minimum value
$c=\$.05$
$i=\$.12$

Since the pipe is homogeneous, the pipe of least annual cost is also the pipe of least amount of metal. We may if we choose, let $c=i=$unity (or we may let $\frac{b}{ci}$ be the constant) and design for minimum amount of metal. The final results will not be affected. We will design therefore for least annual cost.

As a first trial let $b=50$.

To eliminate the unknown coefficient of friction, f, use formulas (5) and (6). From (6)

$$d_1=0.1356\sqrt[6.25]{\frac{b\,q^3}{t'\,ci}}=4.35 \text{ ft.}$$

Run this section (low head) down to $h_1=220$ ft.

Divide the rest of the pipe line into three sections as indicated in figure. From (5)

$$d_2=0.1423\sqrt[5.25]{\frac{b\,q^3S}{ci\,h_2}}=3.70 \text{ ft.}$$

$d_3=3.50$ ft.
$d_4=3.35$ ft.

For the pipe thus determined, the total investment may be calculated, and the total annual income approximated. If the percentage return is the amount specified, the problem is

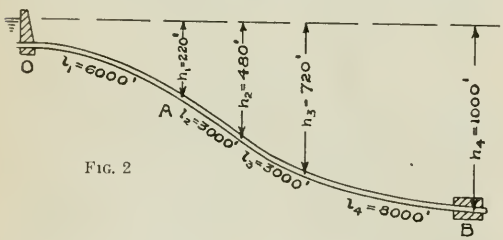


FIG. 2

solved. If not, another trial value for b should be shown. In fact several trial values for b may be successively chosen and a curve drawn with b as abscissa and p, the percentage return, as ordinate. From this curve the proper value for b can be found.

With the diameters of the four sections as determined above, the total loss of head in the pipe line is found to be $h'=49$ ft. The above pipe then for $h'=49$ ft., and for the particular mode of division assumed, is the most economical pipe that can be constructed.

It may be of interest to add the following: If the above pipe of four sections had been designed for a constant diameter throughout but variable thickness of shell, this pipe for $h'=49$ ft., would require 3.5% more metal. If the part AB, the part under high head and consisting of three sections, had been designed for a constant diameter throughout but variable thickness of shell, only 0.8% additional metal would be required. It seems advisable therefore to make the part AB have the same diameter throughout but to change the thickness of shell several times.

If the pipe had been considerably larger, the last statement would not hold. In such a case the saving in the amount of metal required if the pipe under high head is designed for several sections of different diameters and thickness of shell over that required if these sections are designed for the same diameter but different thicknesses of shell may be appreciable. In many cases, however, this saving is not enough to justify the expense of reducers.

The question therefore arises: What is the formula for a pipe or part of a pipe that shall consist of a certain number of sections all of the same diameter but different thicknesses of shell? This question can be readily answered. Referring to Fig. 1, assume that the three sections shall have the same diameter but different thicknesses of shell. Then [see equations (11), (9), (10), and (15)]

$$L=Ad^2\,(h_1\,l_1+h_2\,l_2+h_3\,l_3)+\frac{bq\,C}{8.8\,d^3}\,(l_1+l_2+l_3)$$

This must be a minimum. That is,

$$\frac{d\,L}{d\,(d)}=2Ad\,(h_1\,l_1+h_2\,l_2+h_3\,l_3)-\frac{5\,bq\,C}{8.8\,d^4}\,(l_1+l_2+l_3)=0.$$

Now let

$$(18)\quad h_e=\frac{h_1\,l_1+h_2\,l_2+h_3\,l_3}{l_1+l_2+l_3}$$

and solve for d, and we obtain, for high head,

$$(19)\quad d=0.2153\sqrt[7]{\frac{fbq^2S}{cih_e}}$$

as the required diameter of a pipe (or part of a pipe) that shall have the same diameter throughout but shall consist of a given number of sections of different thicknesses of shell. Formula (19) is the same as formula (1) except that h of (1) must be replaced by h_e as defined by (18). So far as the writer knows, formula (19) is here given for the first time.

Suppose that the part AB of the problem given above shall consist of three sections as shown and that these sections shall have the same diameters but different thicknesses of shell. From (18),

$$h_e=\frac{(3{,}000\times 480)+(3{,}000\times 720)+(8{,}000\times 1{,}000)}{3{,}000+3{,}000+8{,}000}=828 \text{ ft.}$$

Formula (1) or (5) may now be used if h is taken as 828 ft., and the resulting value for d will be the economical diameter of the part AB consisting of three sections of the same diameter but of different thicknesses of shell.

The Corrugated Bar Co., Inc., of New York, announces that it has taken over the entire assets and liabilities of the Corrugated Bar Co., a Missouri corporation, and is continuing the business of the latter company, which is in process of dissolution. This means the retirement by purchase of the Garrison interests, which held the majority of the stock of the Missouri corporation from its inception, in 1891, until the recent reorganization. The control now passes to A. L. Johnson, who has been connected with the company since 1895, and who is now its president.

An information service is being organized by the Associated General Contractors of America, who have established a general office at 111 West Washington St., Chicago, Ill. It is planned to have the manager of the service keep in touch with all the technical and trade papers, and to issue a special bulletin to contractors at least once a month, calling their attention to the best articles on all topics which will be of interest to them. This bulletin will be sent to all of the chief general contractors and construction engineers in the United States, whether members of the association or not, in the hope of stimulating the interest of all general contractors in problems of mutual interest and also in the work of the association.

CANADA'S FUEL PROBLEM — SOME NATIONAL AND INTERNATIONAL ASPECTS

(Continued from page 144)

south-western Alberta, and in the Flathead valley in south-eastern British Columbia.

"In northern Alberta there are enormous tar seepages which evidence an upwelling of petroleum unequalled elsewhere in the world. Along the Athabaska River they extend from Pelican Rapids to Fort McKay, a distance of over 100 miles. The known occurrences indicate that there is in sight at least 6½ cubic miles of bitumen, and the petroleum from which it was derived must have been many times greater. While this enormous amount of petroleum has escaped, there must be untapped reservoirs in the Devonian limestones, whence it was derived. Similar seepages occur near the Peace and Mackenzie Rivers.

"Near Peace River Landing, oil has been found in two wells, 900 and 1,100 ft. deep, respectively. The first well is reported to have yielded three to four barrels per day, when oil was struck in the upper portion of the tar sands and to have had a maximum production of about nine barrels. Drilling, however, was continued through the tar sands, which are about 80 ft. in thickness at this point, and a heavy flow of water and gas was struck immediately below the sands.

"The second well is in the tar sands and is reported to be yielding about 25 barrels per day."

There is marked evidence that Canadians are alive to the important possibilities of the petroleum industry, and the results of the efforts to be made in 1919 are looked forward to with the greatest interest.

Seeking Efficiency in Consumption

Canadians are recognizing the fact that it is fairly incumbent upon them to apply every permanent means within their power to utilize coal in the best and most efficient manner. It is recognized that coal shortage may recur, and therefore, the lessons of the recent shortage must not be forgotten. It is true that the lessons of the coal shortage of 1902-03 were all too soon forgotten, but surely those of the distressing times of the winter of 1917-18 will prove more lasting.

We must not forget the "heatless days"; the times when gasoline could not be used; the denial of fuel for certain luxuries, as use on private yachts; the curtailment of fuel for the manufacture of such apparatus as musical instruments, talking machines, etc.; the allotment to florists for greenhouse purposes of only 50 per cent. of the fuel they were accustomed to receive; the compelled use in certain districts of wood for fuel; the restrictions upon the use of natural gas; the prohibited use in many cases of anthracite and the substitution therefor of bituminous coal; the daylight saving legislation on both sides of the Atlantic; the cutting down of illuminated advertising; and the enforced "lightless nights." These and many other facts must be held in mind as indicating how wide-spread and absolutely necessary have been the efforts for economy with respect to fuel. In the period of reconstruction, and afterwards, the demand for fuel will doubtless be such that many of the restrictions placed upon its use during the war period will in one form and another find permanent expression.

Obtaining Greater Efficiency

In Canada, as in the United States, it is expected that coal consumers will endeavour to effect economies by the systematic employment of every reasonable means which modern progress can devise. Some of such means may suggestively be enumerated as follows:—

In the use of coal generally, great economies may be effected by subjecting the raw bituminous and lignite coals to such by-product and other manufacturing processes as will save the valuable by-products and at the same time produce from inferior grades a satisfactory and clean-burning fuel; by a proper co-ordination of the uses of electricity and coal according to their respective spheres of greatest efficiency; and by a greater utilization of gas. Those interested in the coal-gas-producing industries are looking forward to the greatly increased use of gas and the recovery of by-products, including the coke.* Manufacturers of stoves and heating apparatus are giving serious attention to the production of apparatus more suitable for satisfactorily burning the softer coals.

In the production of power, savings may be effected by taking advantage of the greater efficiency of the modern steam turbine and of large hydraulic units, and by the interconnection, especially over large areas, of various electric plants—whether steam-electric or hydro-electric, or combinations of both—with the object of securing the greatest efficiency in the supply of power and light to districts respectively served.

Effecting Savings of Fuel

By co-ordinated efforts by communities, savings may be effected by staggering the hours of closing of factories, by the adoption of the skip-stop system for street railways, by daylight-saving legislation, by the enactment and enforcement of wise laws, designed to eliminate the wastes resulting from the smoke nuisance.

In manufacturing establishments, savings will be effected by the more efficient use of light and power, by the elimination of uneconomical plants and processes, by the installation of means to use more economical fuel for direct heating, by the substitution wherever possible of hydro-electric for steam-developed power, and by standardization.

By the electrification of steam railways, especially if operated by hydro-developed power, enormous savings in fuel consumption may be made by the reduction of the amount of coal to be hauled, by the saving of energy resulting from the regeneration of electricity by improved methods of braking, by the reduction of the number of buildings and divisional points due to the greater radius of action of electric locomotives, and where fuel-power is employed, by its economical production in large, modern, generating stations. Canada is looking ahead to great development in the near future in the electrification of steam railways. The Ontario government and municipalities already have this problem in hand.

In all such efforts to attain the efficiency possible by intelligent saving and co-ordination, Canada may be relied upon not to fall short of her privileges. Recognizing that the days of the widespread use of anthracite are numbered, her bituminous coals and lignites will be subjected to by-product and other manufacturing processes with the object of producing a satisfactory and clean-burning fuel. Canada does not desire to ignore the march of progress in these fuel problems, nor will she be backward in effecting economies for the prevention of needless fuel and power wastes.

Canada Must Bestir Herself

Now, in conclusion, it must be recognized that anthracite as a fuel is a luxury. Within the last twenty-five years many farmers and citizens, especially in outlying communities where formerly only wood was used, now use anthracite. It became easier and more convenient for the farmer to haul his coal from the railroad siding than to go into the bush and chop his year's supply of wood.

A great portion of this Dominion, like the farmer, has become dependent upon others for coal.

Canada, even though she may regret being deprived of the luxury of clean-burning anthracite or the easily-delivered bituminous coal, must, nevertheless, arouse herself and bestow the necessary intelligent labor upon her own fuel resources in order to make them available for her national needs.

There is no necessity for Canada, with her vast resources of fuel and water power, to go cold or to have her industries throttled by reason of power shortage; but Canada may have a sore trial in both these respects unless every possible effort is speedily made to deal with the fuel and power situation in a comprehensive manner.

Once a broad national policy has been determined, financial and other assistance should be promptly rendered to

*Consult "Possibilities Ahead of the Gas Industry as Revealed by a Digest of Reports from Various Sources," by G. W. Allen in "Proceedings of the 11th Annual Meeting of the Canadian Gas Association," 1918.

(Concluded on page 153)

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CENTRAL HEALTH LABORATORY REQUIRED

DR. C. J. HASTINGS, medical officer of health for the city of Toronto, is reported in a Toronto daily paper as having stated that practically every city is still experimenting with methods of sewage disposal, and that none have yet been able to solve the problem satisfactorily.

"We will be just as well to sit tight and watch experiments in other cities," says Dr Hastings, "as spend money for experiments here. All the so-called better methods are still in the experimental stage."

Dr. Hastings' policy of "sitting tight" and letting others experiment, is hardly the policy that one would expect from a progressive city like Toronto, and it is not likely the policy that the Works Department of that city will take.

Nevertheless, the attitude assumed by Dr. Hastings is not quite so selfish as might appear at first glance. It is undoubtedly founded upon one kind of logic. Milwaukee and other cities have spent many thousands of dollars upon experiments, and Dr. Hastings probably feels that these cities have gone much further in their experiments than Toronto could hope to go for a considerable period, and, as those cities are still spending money for this work, more or less freely, he naturally questions the necessity of Toronto's duplicating the work when he feels that it is already in good hands and is being capably carried out elsewhere.

But is this policy of waiting for "the other fellow" to solve one's problems, the best to pursue? Why should one city spend money in conducting experiments that are of general benefit to all cities? Milwaukee, having spent a certain amount of money in sewage disposal experiments, might very properly say: "We have done our share. Let's stop spending money, and let Toronto, Montreal or some other city finish the work." Then the work would be left to that city which had the most progressive, generous and far-sighted governing officials.

Dr. Hastings' remarks are another reminder that there should be some central bureau, or laboratory, fully equipped with funds and staff for conducting experiments in public sanitation. All problems of general application could then be referred to that bureau and properly taken care of, leaving only purely local problems to be solved by the individual municipalities. Now that the new Department of Health at Ottawa has an official and capable head in Dr. John A. Amyot as deputy minister, it is to be hoped that problems of this kind can be centralized under the direction of that department.

AN IMPROVED COST-PLUS CONTRACT

SEVERAL different forms of percentage contracts have been devised during the past few years in the United States, but a Canadian, J. A. Beatty, of the firm of Morrow & Beatty, Ltd., general contractors, Peterborough, Ont., has inaugurated a form of contract which appears superior in many respects to any other of its kind that has yet been suggested.

The Beatty plan, if it may so be called, has been tried out on a half-million dollar contract for the Southern Canada Power Co., and has resulted, says Mr. Beatty, most satisfactorily, both to the owners and their consulting engineers, and to Mr. Beatty's firm, who were the contractors.

Mr. Beatty's scheme is to charge (tentatively) a fixed fee of 20% on the estimated cost of the work and then, at the end of the job, to pay back to the owners 10% of the total cost of the work, whatever it may be. For instance, if a job were to be estimated by the contractors at a probable cost of $500,000, Mr. Beatty would charge a fixed fee of $100,000. When the job was finally completed, if it were found that the total cost amounted to $550,000, Mr. Beatty would pay the owners $55,000, leaving his firm a profit of $45,000. If the job had only cost, say, $475,000, he would pay the owners $47,500, leaving a profit for his firm amounting to $52,500.

At first glance this does not seem far different from a fixed fee with a bonus and penalty clause. Financially, it is practically no different, but it has two advantages, one of which, especially, is worthy of serious consideration.

First, it is a simpler and more clean-cut way of expressing the contractor's responsibility, and is less likely to result in disagreements or law suits. The owner knows that after he has paid or pledged himself to the fixed fee, whatever the cost of the work may be, he only has to pay 90% of it and the contractor pays 10%. In a simple arrangement of this kind, there is no room for unpleasant misunderstandings as to responsibility for cost having exceeded a certain figure. If the cost of the work be $1,000 or $1,000,000, the contractor pays 10%.

The second and more important advantage of the Beatty plan, the advantage that will appeal to every contractor, is its effect upon the contractor's staff.

Every man on the job knows right from the very beginning that his firm must pay ten cents of every dollar that is spent. When the contractor is not penalized until after the cost has reached a certain figure, the staff is likely to be less careful at the very beginning of the work, perhaps feeling certain that the work will not exceed the estimated cost, and that there is no need for stringent economy or for devising unique methods of saving every possible dollar; and not until the estimated cost has been reached, or nearly reached, and the work is seen to be far from completed, does the real situation impress itself upon the staff; then, when it is too late to prevent a penalty, every effort is made to finish up the job as economically as possible.

Mr. Beatty's plan prevents any laxity right from the start. The contractor and the staff know that they must pay one dollar out of the very first ten dollar bill that is spent on the work, and this direct liability is an excellent incentive to the contractor himself and to his staff to use

all possible brains and energy in carrying out the work in the most ingenious manner from the very first shovelful of excavation.

Engineers, and also contractors, differ in their opinions whether the lump-sum, or unit-price, contract is or is not preferable to the percentage contract. Many articles have been written upon both sides of the subject. But if the percentage contract is to be widely adopted (and it has grown a great deal in popularity during the last few years), we venture to predict that the Beatty plan will be tried by many firms, and that the contractors will find it a very satisfactory form of contract.

CANADA'S FUEL PROBLEM — SOME NATIONAL AND INTERNATIONAL ASPECTS

(Continued from page 151)

enable sane and businesslike development of Canada's lignite, peat and other fuel resources for the benefit of the nation, to be carried out by competent technical officials entrusted with this great and honorable responsibility. As we have already noted the work has been commenced.

Officials of the government of Canada, such as those in the Geological Survey, Department of Mines, the Commission of Conservation, and other organizations, have knowledge of existing conditions and of practical means by which much of the stress may be relieved. To carry out these measures of relief and to place Canada in a reasonably independent position with respect to fuel will take time; but there is no doubt that if matters are dealt with in a broad statesmanlike manner, and the necessary encouragement of financial and other assistance is given to those who are competent, Canada will, at a minimum of effort and expense, be relieved of a menace with respect to her coal supply which threatens not only her economic life, but the well-being of a large proportion of her citizens.

EXHIBITORS AT WATER WORKS CONVENTION

IN the June 19th issue of *The Canadian Engineer* there was published a list of the firms that exhibited at the American Water Works convention, June 9th to 12th, Buffalo, N.Y. It is very much regretted that several names were omitted accidentally from this list. In order to make the record of the meeting complete, it should be stated that in addition to the firms mentioned on page 550 of the June 19th issue, the following firms also had space: National Water Main Cleaning Co., New York City; Joseph Dixon Crucible Co., Jersey City, N.J.; United States Cast Iron Pipe and Foundry Co., Burlington, N.J.; Irving Iron Works Co., Long Island City, N.Y.; Badger Meter Manufacturing Co., Milwaukee, Wis.; McNutt Meter Box Co, Brazil, Ind.; Glauber Brass Manufacturing Co., Cleveland, O.; Richardson Phenix Co., Milwaukee, Wis.; and the Gaunt Co., Knoxville, Tenn.

The damage caused by a recent cloudburst along the line of the Canadian National Railways, between Port Arthur and Winnipeg, was of greater extent than indicated by early reports. Four to ten inches of rain fell during forty-eight consecutive hours. Several miles of roadbed, eight bridges and thirteen culverts were washed away. During the time necessary for repairs to be completed, C.N.R. trains ran on the C.P.R. tracks.

City Architect Pearse, of Toronto, says that the first draft of the revised building by-law is in the hands of the city solicitor. As soon as the latter official is through with it, the first draft of the by-law will be printed. Mr. Pearse says that in the revision of the by-law, three points have been kept in mind, in the following order of importance: First, safety of the public; second, fire protection; third, economy of design. Mr Pearse advocates the establishment in Canada of one or more laboratories for testing Canadian materials.

PERSONALS

LT.-COL. (DR.) JOHN A. AMYOT, C.M.G., of Toronto, has been appointed Deputy Minister of the Department of Health that was recently created by the Dominion Government. Dr. Amyot will go to Ottawa next week and will commence his new duties at once. Prior to going overseas in May, 1915, Dr. Amyot was professor of hygiene at the University of Toronto and director of the laboratory of the Ontario Board of Health. He went overseas with the No. 4 Canadian General Hospital of the University of Toronto. Upon his arrival in England, owing to his extensive experience in sanitation and public health work he was sent to France to take command of the sanitary section of the First Canadian Division. A few months later he was placed in charge of the sanitary organization of the Canadian corps. In September, 1916, his services were requested by the commanding officer of the Second British Army, of which he was appointed assistant director of medical services, in charge of sanitation. Dr. Amyot then had charge of all sanitary work extending from the North Sea to Ypres and Armentieres. He was mentioned in despatches in December, 1917, and was awarded the C.M.G. the following New Year's Day. During the last period of his overseas service, he was consultant on sanitation work to the commanders of the Canadian forces in England. He returned to Canada early last month and is at present enjoying a well-earned vacation. Dr. Amyot was born about 1869 in St. Agathe, P.Q., and was educated at St. Michael's College and at the University of Toronto, from which latter institution he graduated in 1891 with the degree of Bachelor of Medicine.

CAPTAIN DAWSON, recently assistant engineer, Halifax Ocean Terminals, is now practising in Montreal as a consulting engineer.

EX-SENATOR C. D. CLARK, of Evanston, Wyoming, U.S.A., has been appointed a member of the International Joint Commission, succeeding the late James Tawney, of Minnesota. The appointment was made this week by President Woodrow Wilson.

MAJOR T. E. RYDER, D.S.O., M.C., has been appointed general manager of the Rudel-Belnap Machinery Co., Ltd., Montreal. Major Ryder recently returned home in command of the 7th Canadian Siege Battery after having been overseas for four years.

LIEUT. J. E. PRINGLE, formerly of the Queen Victoria's Own Sappers and Miners, Indian Army (Royal Engineers), has been appointed to a position on the engineering staff of the Hydro-Electric Power Commission of Ontario. Lieut. Pringle will be engaged in location work in connection with the "hydro-radials" between Niagara Falls and Toronto.

In an interview with the "Toronto World," Dr. C. J. Hastings, medical officer of health for the city of Toronto, states that if the water of Lake Ontario were not treated, it would not be safe for the people of Toronto to drink it.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand or proposed, contracts awarded, changes in staffs, etc.

ADDITIONAL TENDERS PENDING

Not Including Those Reported in This Issue

Further information may be had from the issues of *The Canadian Engineer*, to which reference is made.

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York Township, Ont., water mains	July 19.	June 26.	52

BRIDGES, ROADS AND STREETS

Barrie, Ont.—The town council proposes to issue debentures to the amount of $10,000 for construction of cement sidewalks, crossings and improvements to roads.

Belleville, Ont.—Debentures will be issued to the amount of $6,635.06 for granolithic sidewalks and $32,871.06 for street pavements. Wilfred Holmes, city clerk.

Calgary, Alta.—The C.P.R. is reinforcing the concrete retaining wall on the Eighth St. W. and First St. E. subways in order to make them waterproof. Excavation is now being carried on along the retaining wall in order to put in th waterproof protection.

Cedardale, Ont.—Tenders will be received by Bowman and Connor, engineers, 31 Queen St. W., Toronto, until noon, July 19th, for the construction of a 73 ft. steel bridge with concrete abutments, or of a concrete arch truss bridge on the base line between Oshawa and Cedardale.

Chatham, Ont.—Tenders will soon be called for paving the River Rd. in Dover Tp. Plans and specifications are with W. C. McGeorge, chairman and engineer of the Roads Commission. There will be no curbing but merely a straight country road with three-foot gravel shoulders.

Cobden, Ont.—The county council has decided to take over the Cobden village road as a county highway. Reeve, W. J. Connelly.

Cobourg, Ont.—The part of the Kingston road, between Port Hope and Grafton, recently taken over by the provincial department of highways will be improved. In addition to grading, widening and draining, the department is putting in reinforced concrete bridges. Tenders have been awarded for 24-foot bridges on the road west from Cobourg, at Gage's Creek, and at Pontiac stock farm on the road east of the town, and at "Sidbrook," just outside the town limits. It has been recommended that the road running from the Home for the Aged to the corner of King and William Sts., be taken over by the department, and property be purchased to straighten the road near the corner of William St. and the Kingston road west of the town, which has a dangerous curve.

Compton, Que.—Contracts for gravelling Sherbrook-Norton road have been awarded to Francis Laroche, Coaticooke, Que.; F. E. Lovell, Coaticooke, Que.; R. E. Willard, Islandbrooke, Que., and L. D. Cairnie, Lennoxville, Que.

Cornwall, Ont.—Work is progressing favorably on the Ottawa-Prescott provincial highway in the neighborhood of Kemptville.

Daly, Man.—Contract for two reinforced concrete bridges and one culvert has been awarded by the municipal council to E. Fulcher, Brandon, Man.

Dundas, Ont.—The town council has awarded contract for 30-inch segment block to Toronto Potteries for $10,175.

Esquimalt, B.C.—Palmer Bros., Vancouver, have been awarded contract by department of public works for grading and paving Island Highway, 2¼ miles. Tender price, approximately $75,000.

Fenelon Falls, Ont.—At a meeting of the Victoria County Good Roads Board, a resolution was carried recommending the construction of a county road of asphaltic concrete, from Leddy Corners to the swamp. The construction is subject to the approval of the highways department.

Halifax, N.S.—The Canadian Bituminous Paving Co., Ltd., Toronto, has been awarded contract for all paving work advertised, with the exception of portions of three streets. The contract for bituminous macadam has been awarded to the Barrett Co., Halifax.

Halton County, Ont.—Contract for the middle road, of stone construction, a distance of 3¾ miles, and for the Milton road, 2¼ miles of waterbound macadam, have both been awarded. Work is expected to commence next week. Halton county intends expending about $130,000 on construction and maintenance this year. The county owns four stone-crushing plants; two of them only are working, one near Milton and the other near Nelson village, each having a capacity of about 100 yards of stone per day.

Hespeler, Ont.—The town council contemplates construction of cement sidewalks on George St. and Adam St. Mayor, L. E. Weaver.

Kingston, Ont.—The department of public works has awarded contract for placing of stone rip-rap along south walls of Lasalle highway, to John F. Sowards, Kingston.

Lindsay, Ont.—The Good Roads Board of the Victoria County Council has decided to construct one mile of permanent pavement in the township of Mariposa. Estimated cost between $20,000 and $27,000.

Lindsay, Ont.—The town council has requested the C.P. Ry. and G.T. Ry. to repair various street crossings in town.

Milton, Ont.—Halton county is at present building a large steel bridge over the ravine at Tansley, on the provincial county road. It is contemplated to construct a similar bridge over the Sixteen Mile Creek in Trafalgar township, about five miles from the Tansley bridge.

Montreal, Que.—A new road is to be built from Montreal to Mont Laurier, a distance of 140 miles. A. David, deputy minister of roads.

Montreal, Que.—Contract for pavements on Sherbrooke St. has been awarded by the city council to Quinlan and Robertson. Tender price, $85,656.

Morden, Man.—Tenders will be received by C. McCorquodale, secretary-treasurer, Morden, Man., until noon, July 23rd, for the construction of reinforced concrete bridge over Dead Horse Creek, on Thornhill Ave. Plans, specifications, tender form and other information may be obtained from the secretary-treasurer, or at the office of the highway commissioner, Parliament Buildings, Winnipeg.

Newmarket, Ont.—Tenders will soon be called for new bridges on Lydia, Prospect and Queen Sts.

Niagara Falls, Ont.—Tenders will be received by city engineer, D. T. Black, until August 4th, for construction of sidewalks.

Niagara Falls, Ont.—Tenders will be received until July 21st for concrete pavements, curb and gutter. W. J. Seymour, clerk. (Official advertisement in this issue.)

Orillia, Ont.—A special grant of $7,500 has been voted by the Simcoe county council for road between Midland and Penetanguishene. This amount will be in addition to $1,000 voted a year ago for this road, besides $1,000 from the townships of Tiny and Tay, and the towns of Penetang and Midland.

Ottawa, Ont.—Tenders will be received by the superintendent, department of Indian Affairs, until noon July 21st, for bridge work. Plans, etc., may be seen at the department

COUNTY OF YORK

TENDERS FOR BRIDGE CONSTRUCTION

Sealed tenders, plainly marked as to the contents, will be received by the undersigned up to 12 o'clock **noon** of **Monday, July 28th, 1919,** for the construction of:—

(1) A reinforced concrete bridge on the town line of East and North Gwillimbury.

(2) A reinforced concrete bridge on the town line of Whitchurch, East Gwillimbury.

(2) A concrete abutment at the Baldwin Bridge, all in the County of York.

Plans and specifications may be seen at the office of the undersigned, 40 Jarvis Street, Toronto.

The lowest or any tender will not necessarily be accepted.

FRANK BARBER,
County Engineer.

Toronto, July 14th, 1919. 297

TOWNSHIP OF YORK

CONSTRUCTION OF WATER MAINS

Sealed tenders, plainly marked as to the contents, will be received by the undersigned engineer for the Municipal Corporation of the Township of York up to 10 o'clock a.m., Tuesday, August 5th, 1919, for the construction of 6-inch cast-iron water mains in the following streets in the Township of York:—

1. Atlas Ave. North (1,124 ft.).
2. Hanson Road, Rockvale Ave., Clovelly Ave., Strader Ave. (2,840 ft.).
3. Miller Ave., Northcliffe Blvd., Westmount Ave. (1,940 ft.).
4 Robina Ave., Cedric Ave., Holland Park Ave., Wilmington Ave. (4,460 ft.).
5. Tay Ave., Glanville Ave., Rushton Road, Durham Ave. (3,370 ft.).
6. Bernice Ave., Eileen Ave., Mildred Ave., Lyndon Ave, Elvin Ave., Scarlett Road (7,190 ft.).
7. Florence Cres., White Ave., Brooke Ave., Pritchard Ave., Jane St. (4,200 ft.).
8. Thornhill Ave., Priscilla Ave., Windermere Ave., Brookside Ave., Bradley Ave. (7,530 ft.).

Plans and specifications and all necessary information may be obtained at the office of the Engineer, Frank Barber, 40 Jarvis Street, Toronto.

The lowest or any tender will not necessarily be accepted.

FRANK BARBER,
Engineer.

Toronto, July 14th, 1919. 298

CONCRETE BRIDGES

Sealed tenders will be received by Mr. H. Roach, Reeve of Uxbridge Township, Goodwood, Ont., up to **6 p.m., Wednesday, July 23rd,** or at the letting at Brechin on Thursday, July 24th, at noon, for the construction of a 28-ft. concrete girder bridge, known as Scott Bridge, at Lot 1, Concession 5, Mara, for the counties of Ontario and Victoria, and for a 24-ft. bridge at Lot 8, Concession 2, Mara, for the Township of Mara. For plans, etc., apply to

BOWMAN & CONNOR,
301 31 Queen St. West, Toronto.

TENDERS FOR 20-INCH CAST IRON PIPES AND VALVES, ETC.

Tenders will be received, by registered post only, addressed to the Chairman of the Board of Control, City Hall, up to noon on Monday, July 28th, 1919, for the construction and delivery of 20-inch cast iron pipes and valves for St. Clair Avenue, from Keele Street westerly, and for laying of same.

Specifications and tender forms for the foregoing may be obtained upon application at the office of the Water Main Extension Section, Department of Works, Room 320, City Hall, Toronto. Envelopes containing tenders must be plainly marked on the outside as to contents. Conditions relating to tendering, as prescribed by City by-law, must be strictly complied with, or tenders may be declared informal. Tenderers shall submit with their tenders the name of two personal sureties, approved by the City Treasurer, or in lieu thereof, the bond of a guarantee company, approved as aforesaid. The lowest or any tender not necessarily accepted.

T. L. CHURCH, Mayor,
302 Chairman, Board of Control.

TENDER FOR SEWER

Sealed tenders, marked "Tender for Sewer," will be received by the undersigned until 5 p.m., Monday, July 21st, for the construction of approximately 7,200 lineal feet of 15-inch sewer. Forms of tender and all necessary information may be obtained at the office of the Town Engineer, Oshawa, Ontario.

The lowest or any tender will not necessarily be accepted.

W. G. WORDEN,
Town Engineer.

Oshawa, Ont., July 14th, 1919. 300

(See page 54 for other tenders called)

of Indian Affairs, Ottawa, Indian agent at Muncey, and at post offices, London and St. Thomas.

Peterboro', Ont.—Contract for the construction of the new Hunter Street bridge across the Otonabee River has been awarded upon a cost-plus basis to the Russell, Townsend Co. Toronto. Estimated cost, about $275,000. Work will commence at once, although the main arch will not be constructed until next summer.

Peterborough, Ont.—The county council has voted $150 to Harvey Tp., to improve North Buckhorn Rd., on condition that Harvey expend $150 and the department of highways $300. Havelock has been granted $150 to be expended on street improvement. The county will raise $14,000 by debentures for the construction and repairing of several bridges.

Point Grey, B.C.—It has been decided by the town council to repair Highbury St. Estimates of costs have been received as follows: Waterbound macadam, at $8,180; oil macadam, $8,625; tarvia, $13,170; and asphalt, $12,450. The council considered only oil macadam and asphalt.

Portage la Prairie, Man.—Arthur Macow, 600 Merchants Bank Building, Winnipeg, has been awarded contract for concrete bridge. Tender price, $6,253.

Portage la Prairie, Man.—Tenders will be received by D. McCowan, secretary-treasurer, Portage la Prairie, Man., until noon, July 19th, for the construction of reinforced concrete culverts. Plans, specifications, tender forms and other information may be obtained at the office of the secretary-treasurer, or at the office of the highway commissioner, Parliament Buildings, Winnipeg, Man.

Regina, Sask.—Contracts for steel and concrete bridges at Wynyard and Theodore have been awarded by the department of highways. There were four tenderers in each case and in connection with every contract the lowest tender was accepted. Following are the contracts: Bridge near Wynyard, W. Newman and Co., Winnipeg, at $3,526; two bridges near Theodore, Parsons Construction Co., Regina, at $3,865 and $4,235.

Regina, Sask.—Tenders will be received until noon, July 30th, by D. A. R. McCannel, acting city engineer, for construction of street pavement and spur track pavement. Official advertisement in this issue.

Rosser, Man.—No tenders were received by the municipal council for excavating hauling and spreading gravel on C.P.R. road. The matter is for the time in abeyance. W. H. Beachell, secretary-treasurer.

Sarnia, Ont.—Tenders will be received by John A. Baird, city engineer, Sarnia, until noon, July 18th, for the construction of concrete curb and gutter. Plans, specifications, etc., may be seen at the office of the city engineer, city hall, Sarnia.

Sarnia, Ont.—The Warren Bituminous Paving Co. have been awarded contract by city council for resurfacing. J. A. Baird, city engineer.

Sherbrooke, Que.—Paving work to be undertaken by the street railway company, as well as work on the West Ward extension, will proceed immediately.

Sherbrooke, Que.—The Loomis-Dakin Co. has been awarded contract for paving in market square. Tender price, $2.54 per sq. yd.

St. Adolphe, Man.—Contract for two miles of road work has been awarded to J. Berriault, St. Adolphe, at $1,200.

ASSISTANT ENGINEER WANTED

Applications addressed to the undersigned will be received until 5 p.m., Monday, July 21st, for the position of assistant Engineer.

Applicants must be experienced in concrete road construction.

W. G. WORDEN,
Town Engineer.

Oshawa, Ont., July 14th, 1919. 299

St. Mary's, Ont.—The cement abutments for the Queen St. overhead bridge have been completed, but the floor girders have not arrived and the work is at a standstill. The cement approach to the station has also been commenced.

St. Rose, Que.—Contract for construction of road has been awarded by the municipal council to O'Connors, Ltd., 204 St. James St., Montreal.

Toronto, Ont.—Construction of brick block pavements and asphalt pavements on two sections of St. Clair Ave., with concrete curbs and gutters, has been recommended by the commissioner of works. Also asphalt pavements on Logan Ave. Total estimated cost, $102,077.

Toronto, Ont.—Tenders will be received by W. A. McLean, deputy minister of highways, until July 30th for concrete structures on provincial highway. (Official advertisement in this issue.)

Toronto, Ont.—The commissioner of works has recommended construction of pavements on Herman Ave., Kenilworth Ave., Oakvale Ave. Estimated cost, $36,799. Also concrete sidewalks on King St. W., McGregor Ave., Silver Ave., Cherokee Ave. Probable cost, $6,738.

Toronto, Ont.—The cost of extending Fairmount Crescent is estimated at about $7,000.

Trail, B.C.—By-laws have been passed authorizing improvements to several streets at a cost of $9,872, and for rock grading costing about $13,100. Also for construction of concrete bridge at a cost of $1,657.

Vancouver, B.C.—Negotiations are proceeding between the department of public works and the municipality and city of North Vancouver in connection with resurfacing 2½ miles of the Marine Drive.

Victoria, B.C.—By-law will be voted on this week for $300,000 for erection of Johnson St. bridge.

Victoria, B.C.—Contract for paving stretch of road between Craigflower bridge and Parsons bridge has been awarded to Palmer Brothers, Vancouver. Tender price, $75,000.

Victoria, B.C.—Improvements are to be made to the River Rd., from New Westminster to Burnaby boundary by the application of a thick coat of oil. Negotiations are similarly proceeding with the municipality of Chilliwack for the hard-surfacing of the main provincial road.

Victoria, B.C.—Some hard surfacing will be effected on Lulu Island. Two or three miles of road are involved.

Wallaceburg, Ont.—Tenders received by the town council for pavements were considered too high. It is proposed to do the work by day labor. C. B. Jackson, town clerk.

Wapella, Sask.—John Grainger, Brandon, Man., has been awarded contract for cement sidewalks. Tender price, 17 cents per sq. ft. for sidewalks and 25 cents per sq. ft. for crossings.

Windsor, Ont.—By-law will soon be submitted to ratepayers to authorize expenditure of $20,000 for two motor driven street flushers at $10,000 each. Also for $100,000 for sidewalks.

Welland, Ont.—Tenders for the construction of either water-bound macadam or bituminous penetration paving on broken stone foundation in the townships of Humberstone and Wainfleet, a distance of about ten miles, and also for ½ mile of concrete pavement or tar penetration surface road on Ridge Road, in the village of Ridgeway, will be received until noon, July 21st, by Robert Cooper, county clerk, court house, Welland. Tenders will also be received for the construction of a water-bound macadam road, 9 feet wide, approximately 2½ miles long, being the balance of road division 16, running south in the township of Humberstone. Plans and specifications can be seen at the office of the county clerk, or at the office of George Ross, county engineer, Welland.

Welland, Ont.—It is reported that the Federal government has provided for the appropriation of $40,000 to build the canal road, the feeder road and that piece of government

Tarvia

Preserves Roads~Prevents Dust

Applying "Tarvia-X" on Kennedy Road, Scarboro Township, Ont. Toronto and York Roads Commission.

The view in the circle is the finished road. Note smooth, dustless surface.

Has Your Town a *Good Roads Program?*

Every town, no matter how small, ought to have a definite road program.

Every county ought also to have one.

Roads should not be built in a patch-work, haphazard fashion, for the only result of such a policy is stretches of good roads interspersed with stretches of bad roads.

As a chain is no stronger than its weakest link, so a road is only as passable as its poorest parts.

Therefore, alternating *good* and *bad* roads are a costly abomination to all who travel over them and all who pay taxes for their construction and maintenance.

Our Service Department has persuaded many towns to work out a systematic road policy ; because we have been able to demonstrate that *great sums of money can be saved* by so doing.

A system of Tarviated macadam—that is to say, macadam that has been bonded with Tarvia to preserve the surface and make it automobile-proof—is an almost indispensable part of every Good-Roads Program today.

Tarvia roads are not only low in their first cost, but exceedingly low in maintenance cost.

Once a town or county adopts the policy of building Tarvia roads it rarely goes backward, but the mileage is increased from year to year.

There are several grades of Tarvia and a dozen methods of using the product.

If you are at all interested we should be glad to mail you an illustrated booklet showing Tarvia roads all over the country that are giving the maximum service and satisfaction at a minimum cost.

Special Service Department

This company has a corps of trained engineers and chemists who have given years of study to modern road problems. The advice of these men may be had for the asking by any one interested. If you will write to the nearest office regarding road problems and conditions in your vicinity, the matter will be given prompt attention.

The Barrett Company LIMITED

MONTREAL TORONTO WINNIPEG VANCOUVER

ST. JOHN, N.B. HALIFAX, N.S. SYDNEY, N.S.

highway between Quaker road and Port Robinson. Work has already commenced on the first two mentioned.

Welland, Ont.—The material for concrete road, from Welland to Port Colborne, has been delivered and work will be commenced at once.

WATER, SEWAGE AND REFUSE

Belleville, Ont.—Debentures will be issued to the amount of $32,871.06 for construction of sewers on several streets. Wilfred Holmes, city clerk.

Bowmanville, Ont.—By-law has been passed authorizing construction of sewer and water works on Duke St.

Burlington, Ont.—Tenders will be received by J. S. Allen, town clerk, until July 25th, for construction of sanitary sewers. Official advertisement in this issue.

Chatham, Ont.—J. W. Teweskbury, Chatham, has been awarded contract for four bridges over Rankin Creek and Cadotte Drains.

Dundas, Ont.—Tenderers for sewers will be invited to tender again on a cost plus fixed profit basis, upon recommendation of the engineer. It was thought by the engineer that the tenders of F. F. Fry and, A. R. C. Smith, which were both about $100,000, were too low, and that the work could not be done for that price.

Dundas, Ont.—The Francis Hinck Co. have been awarded contract for sprinkler equipment by the town council. Ten-per price, $6,888.30.

Dundas, Ont.—The town council has awarded contract for iron pipe to the Gartshore, Thompson Co. Tender price, $2,445.40. Tender of Smart, Turner Co. was accepted for pump, at $2,669. Contract for tile under 30 inches was awarded to the Toronto and Hamilton Sewer Pipe Co., for $23,866.84.

Kenora, Ont.—The town council did not accept any of the tenders for sewers to be constructed in the south ward, and have abandoned the project for this year.

Kingston (Sydenham), Ont.—The department of public works has awarded contract for sewage system and disposal works at convalescent hospital, to W. H. Harvey, Kingston, Ont.

Kitchener, Ont.—The city council plans new water supply and increased fire protection. Estimates of cost of necessary improvements range from $250,000 to $1,000,000. Consulting engineer, Hodgins, Buffalo.

Metcalfe, Ont.—Contract for drainage work on the Grey Creek has been awarded to D. B. Cameron, Berwick, Ont. Tender prices, earth excavation, 30 cents; hard pan, $1.22; rock, $3.25; price per acre for clearing, $50; price per lineal foot for grubbing, 60 cents.

Metcalfe, Ont.—No tenders were received by the town council for Dalglish drain. F. Iveson, clerk.

Newmarket, Ont.—The town council has decided to lay water mains on several streets. P. J. Anderson, clerk.

Orillia, Ont.—The town council contemplates extension of 8-inch water mains on James St., at a cost of about $1,762.05.

Owen Sound, Ont.—Work has been started on new filtration bed at the water works hill. Contractor, John Woolrich.

Shawinigan Falls, Que.—The municipal council has awarded contract for clay pipe sewers, to Edmond Bourassa, Notre Dame St., Three Rivers.

St. Honore, Que.—Plans are being prepared for water works system for the municipal council.

Stratford, Ont.—Tenders will be received by J. D. Fisher, township clerk, R.R. No. 1, Stratford, until noon, July 23rd, for the construction of the McTavish drain in the townships of North and South Easthope. Plans, specifications, etc., can be seen at the clerk's office, Amuhie, or at the office of Jno. Roger, O.L.S., Mitchell.

Three Rivers, Que.—Conroy Bros., 291 Centre St., Montreal, have been awarded plumbing contract for the Protestant School.

Toronto, Ont.—The council of the township of York intends to construct 6-inch cast-iron water mains for service pipes, together with all specials, valves and hydrants, on Right of Way, Hanson Rd., Rockvale Ave., Clovelly Ave., Strader Ave., Miller Ave., Northcliffe Blvd., Westmount Ave., Robina Ave., Cedric Ave., Holland Park Ave., Wilmington Ave., Tay Ave., Glanville Ave., Rushton Rd., Durham Ave., Bernice Cres., Eileen, Mildred, Lyndon and Elvin Avenues, Scarlett Rd., Florence Cres., White, Brook and Pritchard Avenues, Jane St., Thornhill, Priscilla, Windermere, Brookside and Bradley Avenues. Total estimated cost, $129,820.

Windsor, Ont.—By-law will soon be submitted to ratepayers to authorize an expenditure of $15,000 for new fire pump.

Woodslee, Ont.—Contract for improvements to Pipe Creek Drain has been awarded to The Windsor Dredging Co. Tender price, $8,150.

LIGHT, HEAT AND POWER

Creston, B.C.—Extension of electric service to this point is contemplated by the East Kootenay Light and Power Co.

Espanola, Ont.—Contract for installing heating and plumbing systems in school has been awarded to the Cochrane Hardware Co., Sudbury. Tender price, $9,000. Other tenders received as follows: Mitchell and Cooper, Sault Ste. Marie, $13,569; Dominion Plumbing Co., Fort William, $11,-682; Kutchaw Plumbing Co., Sudbury, $11,034; Purdy-Mansell Co., Toronto, $10,692; T. E. Regan, Toronto, $10,350; P. Morrison, Sudbury, $10,285.

Kamloops, B.C.—Development of hydro-electric power at Shuswap Falls on the Adams River is proposed.

Lac du Bonnet, Man.—The Winnipeg River Power Co. has started constructing a large power plant at Lac du Bonnet Falls, on the Winnipeg River, 75 miles north-east of Winnipeg. The project, which will be completed in two years, will cost between $6,000,000 and $7,000,000.

Norwood, Ont.—Negotiations are under way for a right-of way along the C.P.R. track, 15 ft. wide, from Norwood to Peterborough, upon which to build the new hydro-electric power line from Healy Falls.

Outremont, Que.—The city council contemplates extensions to electric light system, with underground conduits, cables, etc. Estimated cost, about $40,500.

Parry Sound, Ont.—The Boving Hydraulic and Engineering Co. have been awarded the contract for hydraulic equipment by the town council. Tender price, $19,270. Other two tenders were from the Morgan-Smith Co., York, Pa., for $24,268 and from the Wm. Hamilton Co., Peterborough, for $22,570.

Peterborough, Ont.—An electric radial from Peterborough to Kinmount is contemplated by the hydro-electric commission. Engineers will survey the route of the territory through which the proposed line is to be built this week.

Port Elgin, Ont.—Engineers of the Ontario Hydro-Electric Commission have prepared plans for power development in the municipalities of Huron and Bruce. It is said that with the Sangueen development scheme and with that at Eugenia, 10,000 h.p. will be available.

Toronto, Ont.—A. Welch and Son, 304 Queen St. W., have been awarded contract for heating and plumbing for new theatre being erected by J. and J. J. Allen.

Toronto, Ont.—The Hydro-Electric Power Commission of Ontario has awarded contract for two 20,000 h.p. water turbines to the I. P. Morris Co., Philadelphia, Pa. These turbines will be used for the Nipigon development. Contract for the generators for same has been awarded to the Canadian Westinghouse Co., Ltd., Hamilton.

Woodbine Heights, York Township, Ont.—Woodbine Heights ratepayers have requested that a hydro-electric lighting system be installed at once. W. Miller, chairman, ratepayers' association.

BURLINGTON

STEEL BARS FOR CONCRETE REINFORCING

STEEL Co LTD

HAMILTON

ROUNDS
SQUARES
TWISTED
SQUARES

BARS BENT TO SHAPE
FOR BEAMS, STIRRUPS ETC

FLATS
CHANNELS
ANGLES
SPECIAL
SECTIONS

PROMPT
SHIPMENT

RAILWAYS

Brantford, Ont.—Extension to street railway is planned by city council. T. H. Jones, engineer.

Lindsay, Ont.—The town council has sent in a petition to bave the radial line extended to this city.

Puslinch, Ont.—Officials of the C.P.R. and G.R.R. have made investigations regarding a proposal to extend the street railway, from Guelph to Puslinch, skirting the lake to Hespeler or Galt, to connect either with the Grand River Electric Ry, or with the Lake Erie and Northern Ry. The city of Guelph recently obtained a charter for an extension of the Guelph Radial to Puslinch Lake and Hespeler.

Toronto, Ont.—It has been decided by the board of works to straighten the northerly curve of the street railway tracks on Broadview Ave., at a cost of $8,231.

FACTORIES AND LARGE BUILDINGS

Alvinston, Ont.—Shultz Bros., Brantford, have the contract for bank building for Merchants Bank of Canada, Montreal.

Arnprior, Ont.—It is the intention of the town council to remodel public school at a cost of $18,000.

Clinton, Ont.—$12,000 will be expended on erection of addition to public building.

Denman Island, B.C.—Tenders will be received by the minister of public works, until noon, July 22nd, for erection of addition to school at Denman Island, in the Comox Electoral District, B.C. Plans and specifications can be seen at the offices of the government agent, Cumberland and Vancouver, and the department of public works, Victoria, B.C. A. E. Foreman, engineer, public works department, Victoria, B.C.

Edmonton, Alta.—Separate tenders on general contract, electric wiring, plumbing, heating, ventilation and farm buildings for agricultural schools at Raymond, Youngstown and Gleichen will be received until July 24th, by L. C. Charlesworth, deputy minister of public works, Edmonton.

Esquimalt, B.C.—The military hospital project, for which $200,000 had been appropriated, has been abandoned by the department of public works.

Ford City, Ont.—R. Westcott and Co., Board of Trade Building, Windsor, has been awarded contract for warehouse, garage, storage tanks and pump-house for Imperial Oil Co., Ltd., 56 Church St., Toronto. Tender price, $28,000.

Fort William, Ont.—By-law will soon be submitted to citizens to raise $75,000 as a nucleus for a larger sum of $250,000 for the purpose of erecting a memorial hall. N. M. Paterson, interested.

Fredericton, N.B.—The directors of the exhibition have decided not to accept any of the four tenders which were received for construction of new transportation building. Arrangements have been made by which the construction of the building will be commenced immediately, with Ald. Judson Barker as superintendent, on a cost plan basis, the plans calling for its completion by August 25th. Estimated cost, $8,000.

Galt, Ont.—Drill hall costing about $13,000 will be erected here.

Guelph, Ont.—Endeavours will be made to secure a technical school in this city.

Guelph, Ont.—Tenders will be received until July 21st, by H. F. McNaughten, secretary, department of public works, Toronto, Ontario, for extension to Macdonald Hall (excepting, heating, lighting and plumbing) and for a piggery, both to be erected on the grounds of the Ontario Agricultural College. Plans and specifications can be seen at the Bursar's office, agricultural college, and at the department of public works, Toronto.

Hamilton, Ont.—Site has been secured on Ottawa St. for new branch library building.

Huntingdon, Que.—The Dominion Bridge Co. have contract for steel work in connection with erection of school.

Huntingdon, Que.—The Merchants Bank of Canada has awarded a contract for bank building to A. F. Byers & Co., 340 University St., Montreal. Tender price, about $20,000.

Kitchener, Ont.—The Canadian Consolidated Rubber Co., Ltd., has decided to expend $1,000,000 on erection of addition to tire plant.

London, Ont.—A joint post-office and custom house will be erected here at a cost of $400,000.

London, Ont.—The Holeproof Hosiery Co. of Canada, Ltd., has awarded contract for factory to Stone and Webster, 147 Oak St., Boston. Tender price, $250,000.

Mayfair, Sask.—Tenders will be received by R. G. Blackwood, architect, for erection of 12-room school for the public school board of Saskatoon.

Moncton, N.B.—The Can. Nat. Rys. has awarded contracts for section houses as follows: At Lapointe, Pecard, Bretagne, Lefebvre, Que., to A. J. Morin, Garthby, Que. At Grog Brook, N.B., to Israel Roy, Green Point, N.B. At Sirois, N.B., and one near Grog Brook, N.B., to Hamilton and Collier, Campbellton, N.B.

Moncton, N.B.—Contract for coaling plant at Sydney, N.S., has been awarded by Can. Nat. Rys. to Williams and Wilson, Ltd., Montreal.

Montreal, Que.—Tenders will be received by Audet and Charbonneau, architects, 194 Parc G. Etienne Cartier, Montreal, until noon, July 21st, for the construction of church and presbytery on Cote St. Antoine Rd., Notre Dame de Grace. Plans and specifications can be obtained on application to the architects.

Montreal, Que.—The Grand Trunk Ry., McGill St., plans erection of additional storage warehouse.

Preston, Ont.—The Bank of Toronto has decided to erect a new bank building on the corner of King and Wellington Sts. at a cost of about $60,000. Plans and specifications have been prepared.

Quebec, Que.—E. Cormier, New Birks Building, Montreal, is the architect for the new $500,000 factory to be erected for the Marceau Oil Cloth Co.

Regina, Sask.—Plans for the war memorial museum to be erected by the provincial government in the legislative grounds have been received from the architects who were invited to compete, and will be sent on by the department of pubic works to Dr. Ramsay Traquair, professor of architecture at McGill University, and Stephen Warrick, Montreal, the assessors. Under the terms of the contest the successful architect must be announced within twenty-one days of the closing of the competition. Those who are invited to compete are as follows: Brown and Vallance, Montreal; Emil Delay, Regina; E. and W. S. Maxwell, Montreal; Nobles and Hyde, Montreal; J. H. G. Russel, Winnipeg; Storey and Van Egmond, Regina; R. G. Bunyard, Moose Jaw; and David Webster, Saskatoon.

Sault Ste. Marie, Ont.—The extension of the rail mill of the Algoma Steel Co.'s plant, which was announced several weeks ago, and which will cost several hundred thousand dollars, is but the beginning of an extensive development of the plant, it is stated. The whole plan laid out by the officials of the company involves an expenditure of from five to seven million dollars, and includes the production of structural steel shapes of all kinds and sizes.

Three Rivers, Que.—MacDuff and Lemieux are the architects for creamery to be erected on St. George St. Estimated cost, $10,000.

Three Rivers, Que.—The Phœnix Bridge and Iron Works, Ltd., Montreal, have been awarded contract for technical school. Tender price, about $150,000.

Toronto, Ont.—J. and J. J. Allen have awarded steel contract for theatre on Waverly Rd. to Canadian Allis-Chalmers, Ltd.

Toronto, Ont.—Tenders will be received by Darling and Pearson, 2 Leader Lane, Toronto, until July 28th, either in bulk or for separate trades for all work required in the erection of a building for the electrical department of the University of Toronto, on ground adjoining the mining building.

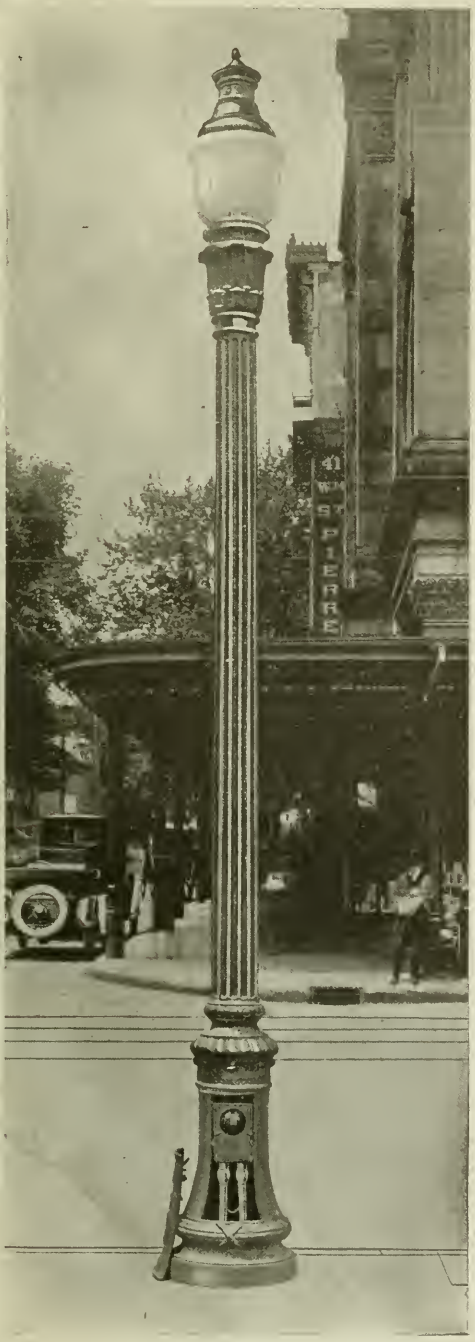

FIGURE 3

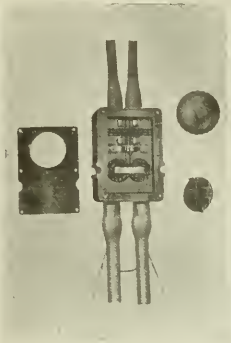

FIGURE 1—FRONT

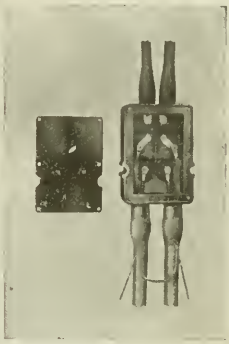

FIGURE 2—REAR

THE "S.J.B." BOX

FOR SERIES ORNAMENTAL STREET LIGHTING SYSTEMS

¶ To provide a means of disconnecting lamps from circuits supplied with current by two-conductor cable, The Northern Electric Company have recently designed the "S.J.B." Box for use on series circuits operating at potentials of 7,000 volts or less.

¶ Figs. 1 and 2 show front and rear views of the box, and Fig. 3 shows how the box is installed in the pedestal of a lamp standard. This view was taken in Montreal where all of the standards used in connection with the new lighting system are equipped with these boxes.

¶ There are many interesting features in connection with this box, but the limited space at our disposal does not permit of a detailed explanation. To those interested, however, we will be glad to send photographs and full descriptive matter on application to our nearest branch house.

Northern Electric Company
LIMITED

MONTREAL	TORONTO	REGINA
HALIFAX	LONDON	CALGARY
OTTAWA	WINNIPEG	VANCOUVER

Plans and specifications may be seen at the office of the architects.

Toronto, Ont.—Two Catholic institutions have secured site and will erect building as centre of activities for diocese. Estimated cost, $500,000. Organizing president, H. E. Car-

Walkerville, Ont.—Tenders will soon be called by The Peabody Manufacturing Co. for factory. Estimated cost, $500,000.
dinal.

Windsor, Ont.—J. C. Pennington, Windsor, architect, has prepared plans for new factory for B. N. Marsh. Estimated cost, $30,000.

Windsor, Ont.—Plans have been prepared by A. H. McPhail, architect, for $1,000,000 worth of building including two schools and mausoleum.

Winnipeg, Man.—Building permits totalling $147,000 were issued on June 10th. They include: Imperial Bank, Arlington St., Fraser and McDonald, architects, $8,000; school house, Talbot Ave., $20,000; school house, Oak Ave., $20,000; brick warehouse, for Twin Separator Co., Whyte St., $21,000; tannery on Winnipeg Ave., $2,500; Bank of Hamilton alteration, Portage Ave., A. J. Bonnett, contractor, $7,500. A permit will soon be issued for the Jewish Orphanage building on Matheson Ave., for $60,000, to be built by the Sutherland Construction Co.

Winnipeg, Man.—Tenders will be received by C. J. Brown, city clerk, Winnipeg, until 3 o'clock, July 28th, for the supply of all labor and materials required for the erection of a two-story and basement garage building for the city light and power department. Instructions to bidders, plans and specifications and form of tender may be obtained at the office of J. J. Chisholm and Son, architects, 703 Great West Permanent Building.

MISCELLANEOUS

Collingwood, Ont.—Reconstruction of breakwater will cost $50,000.

Edmonton, Alta.—The municipal council contemplates an expenditure of $260,000 on further extensions and additions to municipal telephone system. Chas. Ed. K. Cox, city clerk.

Fredericton, N.B.—The New Brunswick Telephone Co. plans improvements and extensions to system at a cost of about $175,000.

Grosse Isle, Que.—Tenders will be received until noon, August 5th, by R. C. Desrochers, secretary, department of public works, Ottawa, for the construction of an extension to the eastern wharf at Grosse Isle Quarantine Station, County of Montmagny, Que. Plans and forms of contract can be seen and specification and forms of tender obtained at the department of public works; at the offices of the district engineers at Montmagny, Que.; post-office building, Quebec, Que., and Shaughnessy Building, Montreal, Que.

Ha! Ha! Bay, Que.—The J. T. White Engineering Co., New York, have been awarded contract for concrete wharf. Tender price, $400,000.

Hamilton, Ont.—Tenders will soon be called for harbor improvements, to cost $100,000.

Kamloops, B.C.—The Kamloops Copper Co. contemplates diversion of water from Iron Mask Lake, the water to be used for milling and concentrating purposes at the mine. A Wallinder, agent.

Kenora, Ont.—A new wharf at Rideout Bay, on the Winnipeg River, will be constructed by the Federal Government. Estimated cost, $4,000.

Nanaimo, B.C.—Tenders will be received by R. C. Desrochers, secretary, department of public works, Ottawa, until noon, Friday, July 25th, for the construction of repairs to wharf at Sydney, repairs to floor and approach at Roberts Bay and repairs to wharf at Saanichton. Plans and forms of contract can be seen and specification and forms of tender obtained at the department of public works, at the office of the district engineer, Victoria, B.C., at the post-offices, Vancouver, B.C., Sydney, B.C., and Turgoose, B.C.

Okanagan Centre, B.C.—Tenders will be received until noon, August 5th, by R. C. Desrochers, secretary, department of public works, Ottawa, for construction of wharf. Plans and specifications may be seen at the office of the district engineer and at post-office, Okanagan Centre.

Ottawa, Ont.—Contract for dredges P.W.D. No. 110 and P.W.D. No. 116 has been awarded by the department of public works to M. Beatty and Sons, Ltd., Midland, Ont.

Plunkett, Sask.—The Plunkett Rural Telephone Co. will receive tenders until July 21st for the construction of extensions of systems. Plans and specifications are on file at the department of telephones, Regina, or at the office of the secretary of the company. J. H. F. Armitage, secretary-treasurer, Plunkett, Sask.

Port Maitland, Ont.—$200,000 will be expended by the department of public works for erecting portion of east pier.

Prince Rupert, B.C.—George B. Hull, resident engineer for the Federal Government, has been notified that appropriations have been made for a survey of Skidegate Narrows, Metlakatla Bar and the fishermen's wharf at Seal Cove. Plans have also been received from Ottawa for public float to be constructed at Port Essington.

Spry Bay, N.S.—The department of public works has awarded contract for extension to wharf to A. W. Girroir and W. F. MacKinnon, Antigonish, N.S.

St. Gregor, Sask.—Tenders will be received by Thos. Coughlan, secretary-treasurer, St. Gregor Rural Telephone Co., Ltd., until July 25th for extensions to system. Plans may be seen at the department of telephones, Regina.

St. Ignace de Loyola (Nord), Que.—Onésima Poliquin, Portneuf, Que., has been awarded the contract for reconstruction of wharf and approach by the department of public works.

Three Rivers, Que.—Tenders will be received until noon, July 24th, by R. C. Desrochers, secretary, department of public works, Ottawa, for dredging channel and basin in the eastern outlet of the River St. Maurice. Combined specifications and forms of tender can be obtained on application to the secretary, department of public works.

Toronto, Ont.—It has been decided to expend about $125,000 for improvements and extensions to parks in the eastern section of the city. Appropriations have been made as follows: Ramsden Park, $15,000; Allan Gardens, $10,000; Riverdale, Withrow and Monarch parks will also be remodelled.

Toronto, Ont.—It has been proposed by Mayor Church to erect a pier in the lake at the exhibition grounds.

Vancouver, B.C.—Engineers are taking borings for the new C.P.R. pier which is to be constructed between piers "A" and "D." It is understood that the engineers are finding a good bottom for the location of the structure and that a solid foundation can be secured at a reasonable depth. The new pier will be of sufficient proportions to accommodate the largest liners.

Vancouver, Id., B.C.—Wharves will be reconstructed at Ladysmith, Sydney, South Gabriola, Port Renfrew and Fulford Harbor. Repairs will be made to wharves at Wakes Bay, Saanichton, Esquimalt, William Head and Robert's Bay.

Victoria, B.C.—Tenders will be received by the Land Settlement Board, until noon, July 21st, for the construction of a ditch through parts of district lots 7, 81 and 90, New Castle district, and part of district lot 1, Cameron district. Plans, specifications and approximate estimate of the work necessary to be performed may be seen at the office of the "Daily Herald," Nanaimo, B.C., at the office of "The Columbian," New Westminster, B.C., or at the office of the Land Settlement Board, Victoria, B.C.

Welland, Ont.—Contract for supply and delivery of sand required on the Welland Ship Canal has been awarded by the department of railways and canals to the National Sand and Material Co., Ltd., Welland, Ont.

Wilkie, Sask.—Contract for extension to Narrow Lake Rural Telephone system has been awarded to T. W. Brown, Saskatoon. Tender price, $8,690.

The Canadian Engineer

A Weekly Paper for Civil Engineers and Contractors

Point St. Charles Filtration Works, Montreal

Results of First Year's Operation—Output from Start Slightly Over Full Rated Capacity—Efficiencies During Last Nine Months from 96.2% to 99.1% Without Chlorination, and from 98.1% to 99.8% With Chlorination

DURING the twelve months ended June 30th, 1919, constituting the first year's operation, the Point St. Charles filtration works, Montreal, averaged 50.3 million gallons daily of filtered water. This is slightly more than the full rated capacity, the plant having been designed for a nominal daily output of 50 million gallons.

Montreal's requirements have grown to such an extent that the output of this municipally-owned plant was insufficient, despite the fact that thousands of consumers are supplied by another plant (owned by the Montreal Water & Power Co.); therefore an average of 12.8 million gallons of raw river water was added daily to the 50.3 million gallons of filtered water, and the mixture was effectively chlorinated.

The accompanying table gives the results of the daily chemical analyses, averaged for each month. July, 1918, was the first month after operation commenced for which complete data of all laboratory tests are available, the months of April, May and June, 1918, having been required for regulating the plant and correcting intake troubles due to frazil. In this first month of actually complete operation, with a raw water count of 530, the pre-filters showed 87.9% bacterial efficiency, and the final filters, 95.3%. The filtered water was mixed with 16.1 million gallons of raw water, and the mixture was chlorinated, the final bacteria count of the water as delivered to the mains showing 93.7% removal.

The bacteria-removal figures vary considerably until the end of September, 1918, at which time the plant appears to have been "tuned up" to an average condition or efficiency.

From October, 1918, to June, 1919, both months inclusive, the final filter bacterial efficiency ranged from a minimum of 96.2% in June, 1919, to a maximum of 99.1% in May, 1919. The bacteria-removal of the combined raw and filtered water (after chlorination) ranged, in the same period, from a minimum of 98.1% in October, 1918, to a maximum of 99.8% in April, 1919.

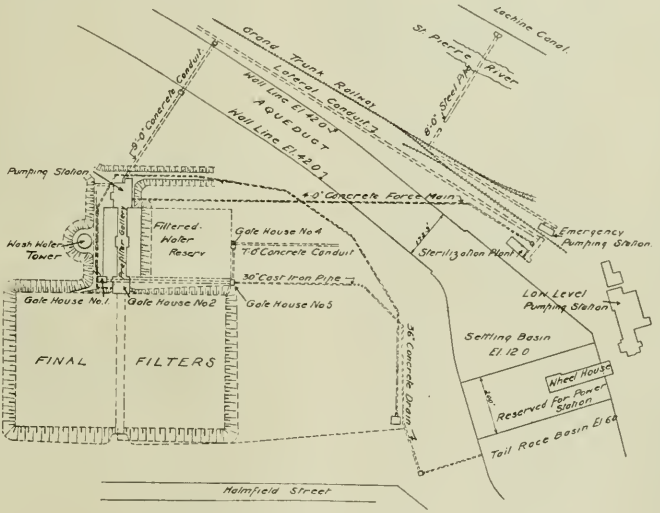

FIG. NO. 1—GENERAL PLAN OF FILTRATION WORKS

The plant has both a shore intake and a mid-stream intake situated about two miles above the Lachine Rapids of the St. Lawrence River. From an entrance gate chamber which receives the supply from both intakes, a concrete conduit, 8.5 ft. in diameter, formerly conveyed the water to the low level pumping station, from which it was pumped through the distributing mains to the city's reservoirs.

For many years the excessive number of cases of and deaths from typhoid fever had demonstrated to Montreal's citizens the necessity of improving the quality of the water used for domestic purposes. The increasing pollution of the water supply, due to the discharge of sewage and other impurities from towns within the drainage area above the intakes, is indicated by Fig. No. 8, which shows graphically the total number of deaths, and the death rate per 100,000 population, from typhoid fever for a long period of years.

During the late fall and winter of 1909-1910, a severe epidemic of typhoid fever prevailed in Montreal and its suburbs, and occasioned 203 deaths between October 1st, 1909, and March 1st, 1910. The necessity for prompt action was recognized by the city officials, and the chlorination of the municipal water supply was started February 8th, 1910, and has been regularly continued to the present time.

Hering & Fuller, consulting engineers, New York City, were instructed April 4th, 1910, to report on the best means of securing an improved water supply. These engineers submitted their report July 2nd, 1910, and recommended filtration of the St. Lawrence River water. Their recommendation was adopted and they were engaged to co-operate with the late Major Georges Janin, then city engineer, in preparing plans and specifications and in supervising the construction of the works.

A 9 ft. concrete conduit, connected to the 8.5 ft. main supply conduit previously mentioned as having supplied the low level station, brings the untreated St. Lawrence River water to the filtration pumping station. The purpose

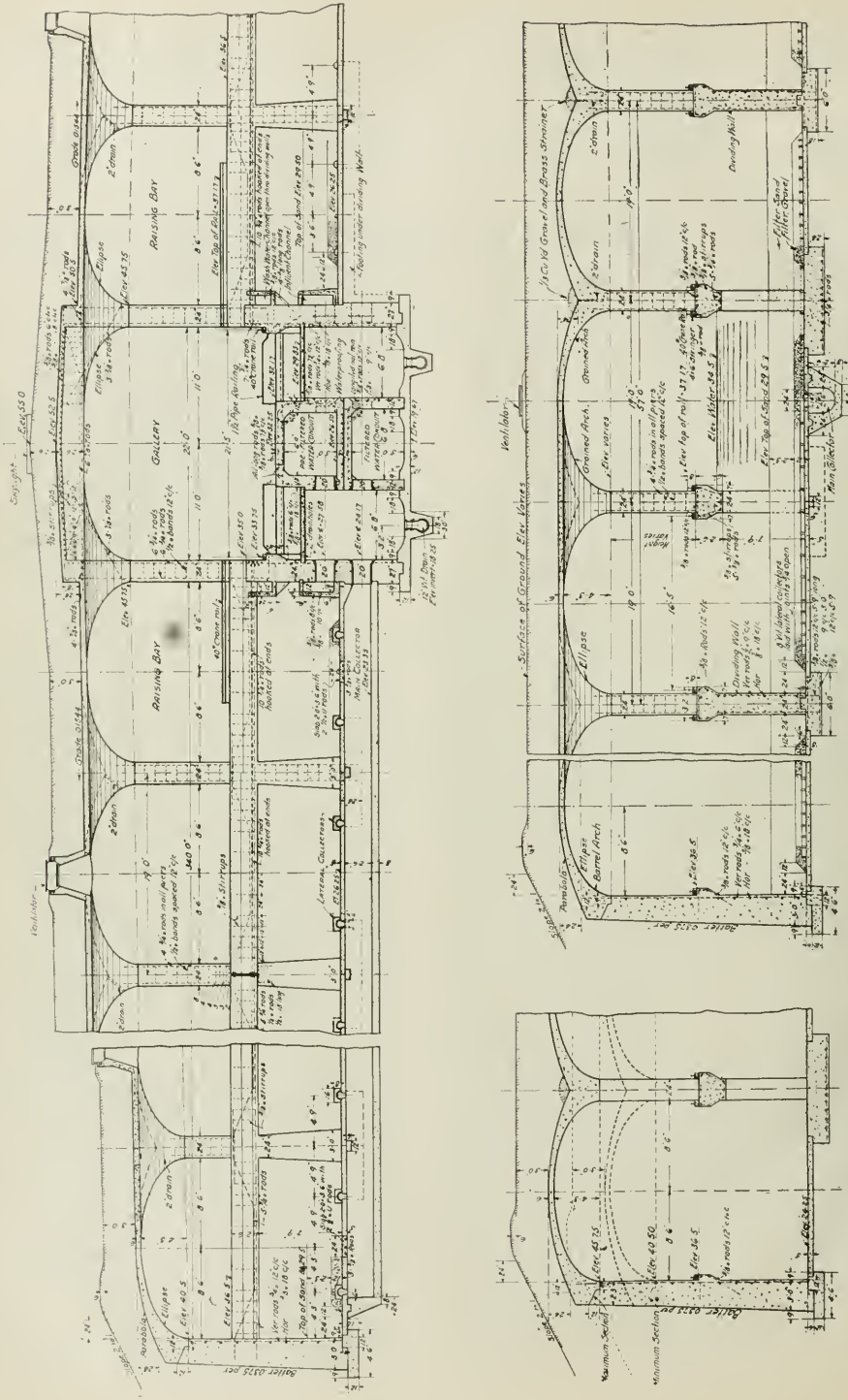

FIG. No. 2—SECTIONS THROUGH FINAL FILTERS, POINT ST. CHARLES FILTRATION WORKS, MONTREAL

of this pumping station is to lift the water to the prefilters, a height of approximately 18 ft., and to furnish water at a higher pressure for washing the prefilters at times of cleaning.

From the prefilters, or rapid filters, which form the first step in the purification process, the water flows by gravity to the final filters, which are quite similar in construction to slow sand filters. Passing through the final filters, the water flows into the filtered water reservoir, and is subsequently chlorinated.

From the filtered water reservoir, the water flows to the filtration pumping station, from which it is pumped to the low level pumping station, where it is forced by high pressure pumps through the distributing mains and to the city's reservoirs.

Should the proposed aqueduct enlargement work be completed, the filtered water will not return to the filtration pumping station but instead will flow by gravity from the filtered water reservoir to a new hydro-electric pumping station at the end of the aqueduct, and from that point will be delivered to the mains.

The filtration pumping station is a two-story structure about 80 ft. by 60 ft. The lower story is below the ground level and is traversed by the raw-water suction conduit and the raw-water discharge conduit, which are placed one upon the other. The direct-connected, motor-driven centrifugal pumps are arranged on either side of the central conduits in such manner as to obtain their supply from the lower, or suction conduit, and deliver into the upper or discharge conduit with a minimum of piping connections. Four of the pumps on the north side of the station are also similarly connected to a filtered-water suction conduit and a filtered-water discharge conduit, and provided with suitable check and controlling valves, equipped with standard hydraulic cylinders. This permits of one or all of these pumps on the north side of the station to be used for delivering filtered water to the low level pumping station. Should a new hydro-electric pumping station be completed, and the filtered water flow to it by gravity, all raw water pumps in the filtration pumping station will be available for supplying the filters.

The pumping station includes the following units:—

4	Raw water pumps	17,500 Imp. gals. per min.
2	Raw water pumps	11,600 Imp. gals. per min.
2	Raw water pumps	5,800 Imp. gals. per min.
2	Wash water pumps	1,300 Imp. gals. per min.
1	Sump water pump	330 Imp. gals. per min.
1	Sump water pump	150 Imp. gals. per min.
1	Three-inch hydraulic pressure pump	90 lbs. pressure.
1	Rotary blower	5,000 cu. ft. air per min.

All of these pumps, with the exception of the 3-in. hydraulic pressure unit, were installed under the original contracts. The 3-in. pump was installed for emergencies, to keep the pressure in the new hydraulic system uniformly 90 lbs.

The blower and the wash water pumps are used in cleaning the pre-filters. The sump pumps remove seepage and drainage water. The six largest pumps and the blower are operated by motors using 2,200-volt alternating current. The other pumps operate under 550-volt current.

The upper story of the pumping station is above the ground level and, similar to all other buildings of the plant, has red brick walls and cinder concrete roofs covered with green tile. The north side of this upper story contains the chemical laboratory. The south side contains rooms for storage, etc.

The pre-filters, located east of and adjoining the pumping station, and supported by groined arches above the roof of the filtered water reservoir, are sixteen in number, each having a net filtering area of 1,200 sq. ft., arranged eight on each side of a central operating gallery. Each pre-filter is divided longitudinally by a central gutter into which empty the sixteen lateral reinforced concrete wash water gutters. The strainer and air system is made up of cast iron headers and 2-in. cast iron laterals, with brass strainers spaced at 6-in. centres. The filtering material consists of 15 ins. of gravel, graded into four sizes and placed in corresponding layers, and 30 ins. of filter sand. The details of a pre-filter unit is shown in Fig. No. 4.

Longitudinally through the centre of the operating gallery are two concrete conduits, placed one upon the other.

TABLE SHOWING PERFORMANCE DURING PAST YEAR OF POINT ST. CHARLES FILTRATION WORKS, MONTREAL

	Average Daily Consumption				Turbidity			Bacteria Count				Bacterial Efficiency—Per cent.		
1918	Filtered Water	Raw Water	Total	Chlorine Used P.P.M.	Raw Water	Pre-filtered Water	Finally Filtered Water	Raw Water	Prefiltered Water	Finally Filtered Water	Raw and Filtered Water Mixed—After Chlorination	Pre-filters	Prefilters and Final Filters	Filtration and Chlorination of Mixed Water
July	49.3	16.1	65.4	0.22	10	5	2	530	64	25	33	87.9	95.3	93.7
Aug.	50.1	16.4	66.5	0.22	10	4	2	375	46	31	17	87.7	91.8	95.4
Sept.	50.8	14.4	65.2	0.14	10	4	2	450	49	32	9	89.1	92.9	98.0
Oct.	50.8	11.8	62.6	0.18	12	5	2	951	231	26	18	75.7	97.3	98.1
Nov.	50.7	11.1	61.8	0.23	20	7	2	1,936	618	34	18	68.1	98.2	99.0
Dec.	50.7	10.6	61.3	0.24	16	6	2	3,050	1,360	57	15	55.4	98.1	99.4
1919														
Jan.	50.5	12.9	63.4	0.22	8	4	2	2,950	940	31	6	68.1	99.0	99.7
Feb.	51.2	10.7	61.9	0.12	7	3	2	2,380	700	30	15	70.6	98.8	99.3
Mar.	50.6	11.1	61.7	0.19	10	4	2	8,690	2,650	226	57	69.5	97.4	99.3
Apr.	46.9	12.9	59.8	0.60	28	6	3	9,520	1,836	117	20	80.7	98.8	99.8
May	50.5	9.6	60.1	0.60	18	7	3	5,500	440	50	20	92.0	99.1	99.7
June	51.0	16.2	67.2	0.53	15	6	2	1,477	132	55	22	92.4	96.2	98.5

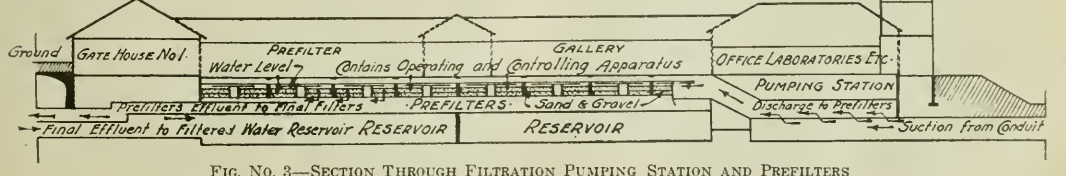

FIG. NO. 3—SECTION THROUGH FILTRATION PUMPING STATION AND PREFILTERS

The upper one is the raw water supply conduit from the filtration pumping station and the lower is the pre-filter effluent conduit leading to the final filters. These two conduits are connected to the pre-filters by cast-iron piping with hydraulic controlling valves. All these valves and also the valves for wash water, air and drainage are controlled from sixteen operating tables on the gallery floor, each table being located in front of its corresponding filter.

For controlling the rate of filtration, rate controllers of the "Earl" type are provided. These are so connected to a master controller that the discharge from the pre-filters is automatically adjusted to the discharge from the final filters, which in turn is similarly controlled automatically by

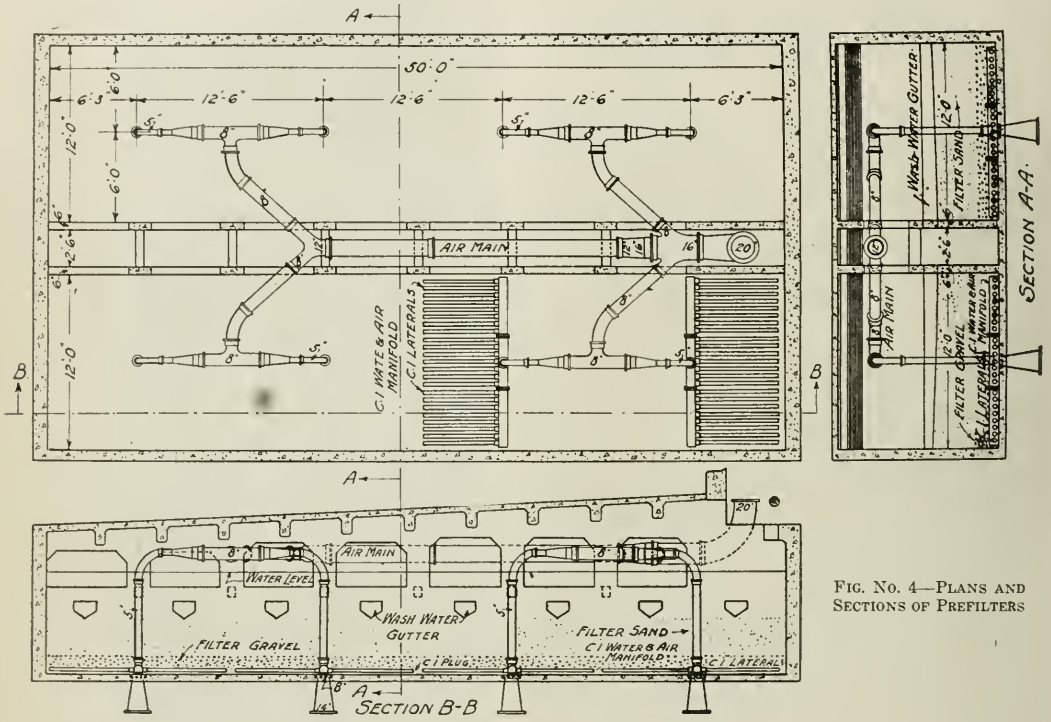

FIG. No. 4—PLANS AND SECTIONS OF PREFILTERS

the amount of water being drawn from the filtered water reservoir. In other words, the plant as a whole delivers filtered water at the same rate as it is used in the city, without manual operation of the many controlling valves.

The final filters are sixteen in number and, similarly to the pre-filters, are arranged eight on each side of the operating gallery. The filters are covered by groined arches supported by piers spaced at 19 ft. centres. The pier load is carried on foundation blocks independently of the rest of the floor, which is flat and but 5 ins. thick. The filters are each 55 by 340 ft., inside measurements, with the short dimension adjoining the gallery to accommodate the use of Blaisdell washing machines for the filter cleaning.

The underdrainage system consists of two half-round 8 in. tile laterals in each bay, which discharge into a central main collector, 2½ ft. in diameter, extending the entire length of the filter below the floor level. The filter material includes 12 ins. of graded gravel, placed in four layers, and 27 ins. of sand. The conduits and piping connections in the gallery, including the Earl rate controllers, are similar to those of the pre-filters.

The Blaisdell washing machines travel on tracks supported by the piers. They wash the upper layers of sand, leaving the sand bed clean and uniform, and pump away to the drains all dirt and other foreign matters which may have accumulated since the previous washing. All this is accomplished at one operation and by one operator. Among the advantages of this method of cleaning the filters, says Fred E. Field, assistant superintendent of water works of city of Montreal, are that the length of time the filter is out of service is a minimum, being from 6 to 8 hours only; the removal of the dirt from the sand is more complete than can be done by hand cleaning, as the cleaning process extends to any desired depth below the surface of the sand; the sand bed is left more uniform and without the compacting which accompanies walking over the sand by workmen; there is no break in the routine of the work during the winter and no decrease in the effective filtering area.

A heating and ventilating system is provided to prevent skim ice forming during the winter months and interfering with the free movement of the washing machines, and also to make the plant more healthful and comfortable for the workmen. This system consists of a fan and air ducts so arranged that heated air can be blown uniformly over the entire area of the filters. It was not found necessary, however, to use this system during the past winter.

The filtered water reservoir is of concrete, with groined arches for the roof and inverted groined arches for the floor. It is about 430 by 232 ft., and has a capacity of 6¼ million Imperial gallons. With the exception of its use to control the output of the plant, as has previously been described, there is nothing unusual in its design or method of operation. It was found necessary, however, in June, 1918, to place a bulkhead of stop-logs in gate-house No. 3, for its entire depth, to force the filtered water coming from the final filters through the east side of the reservoir, through a series of baffles, to the suctions of the pumps on the west side, thus eliminating the dead water which was found on the east side of the reservoir.

A butterfly valve was also placed on the filter effluent to prevent overflow of the filtered water reservoir into the pumping station. This valve can be closed rapidly but, in so doing, the final filters are disturbed. The usual practise, on occasion of power failure, if of more than five minutes' duration, is to close the sixteen filters by releasing each automatic valve. This, while not so rapid as the action of the butterfly valve, preserves the filter formations intact.

The filtration works uses electric current for power, heating and lighting. The city obtains current from the Montreal Light, Heat & Power Co., which has a 10,000-volt transmission line near the works. Branch connections from this transmission line bring 10,000-volt alternating current to the filtration transformer building, where it is reduced to 2,200 volts and then transmitted through an underground conduit system to the filtration buildings. Here it is used at 2,200 volts for the motors operating the main pumps or reduced by transformers to 550 and 220 volts for other machinery and for lighting and heating.

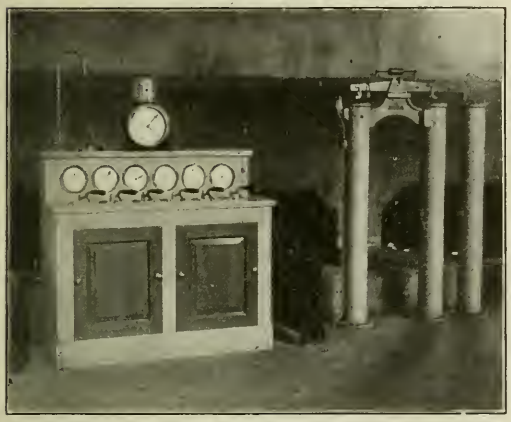

FIG. NO. 5—PREFILTER OPERATING TABLE AND AUTOMATIC CONTROLS

Heating throughout the entire works is accomplished by means of electric radiators.

The Blaisdell machines require direct current. Consequently a motor-generator set is provided to supply this current to the machine motors through the three miles of double trolley lines by which the machines are operated in the final filters.

The cost of the plant is given in the following table:—

FILTRATION CONTRACTS

	Cost
Pumping machinery, blower and cranes, British Electric Plant Co.	$ 40,250.00
Final filters and appurtenances, F. H. McGuigan, transferred to Norman M. McLeod	674,436.20
Prefilters and filtered water reservoir, F. H. McGuigan, transferred to Norman M. McLeod	498,782.30
Pumping station, wash-water tower and buildings, F. J. Jago Co.	160,076.00
Interior painting, Charles Larin	1,815.42
Exterior electrical conduit system, G. M. Gest.	6,069.80
Underground electrical cables and appurtenances, Northern Electric Co., Ltd.	12,627.04
Transformer building, city of Montreal	6,000.00
Total cost	$1,400,056.76

The operating tables, gauges, the strainer system and other filter equipment were supplied by the Roberts Filter Mfg. Co., of Darby, Philadelphia, Pa. The rate controllers were supplied by the Pittsburgh Filter & Engineering Co., of Pittsburgh and Oil City, Pa.

After practically all of the above contracts were completed, the operation of the plant was prevented by the lack of proper filter sand. The earlier contractors endeavored to obtain filter sand and gravel from numerous locations around Montreal Island, but they were all found

FIG. NO. 6—EXTERIOR VIEW, POINT ST. CHARLES FILTRATION WORKS, MONTREAL

to be unsuitable. A plant was finally erected under the design of W. B. Fuller, formerly of New York, and was located at Pierreville, near Lake St. Francis.

A suction dredge was used and the material was washed in tanks and then graded by passing through suitable revolving screens. The gravel was treated in similar manner. It was found that the available sand properly graded for the pre-filters ran about 50% of the quantity handled to obtain same. The sand for the final filters was found in different pockets, under water, practically graded to conform to specifications. This sand ran close to 100% of the quantity pumped.

The total quantity of sand required for the pre-filters, ranging from 0.40 to 0.50 mm. in diameter, was 2,000 cu.

FIG. NO. 7—PREFILTER GALLERY

yds.; that for the final filters, ranging from 0.25 to 0.35 mm. effective size, was 27,000 cu. yds. The total quantity of gravel for the pre-filters was 800 cu. yds.; the final filters required 8,000 cu. yds.

When the design of the Point St. Charles filtration works was started, the amount of water supplied by the municipality was about 37 million Imperial gallons daily. The filtration works were designed for a nominal capacity of 1½ times the requirements at that time. It was realized that extensions to the filters would be required in a few years, and the design allows for extensions with but little difficulty and without serious disturbance of the regular operation of the plant.

Annexations of adjoining municipalities, and the large extension of the city's water distribution system, have been more rapid than was expected. The new plant was required to work to full capacity from the day it was put into service and is now inadequate. The need for immediate action to provide for a much greater daily capacity of filtered water is so apparent that the city will undoubtedly

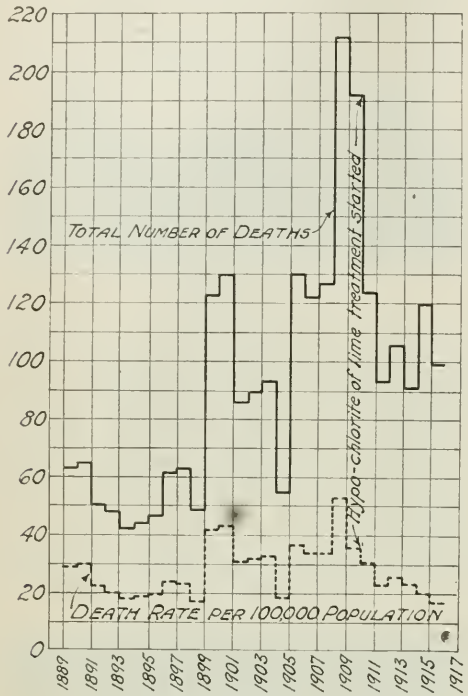

FIG. NO. 8—GRAPH SHOWING DEATHS FROM TYPHOID, 1889 TO 1917, CITY OF MONTREAL

in the near future let contracts for extension of the present works.

The original design contemplated the ultimate enlargement of the plant, it is said, along the following lines:—

Conversion of the final filters into slow sand beds,—capacity	30,000,000 gals.
Conversion of the pre-filters into mechanical filters,—capacity	40,000,000 gals.
Construction of two additional batteries of mechanical filters,—capacity	80,000,000 gals.
Total daily capacity	150,000,000 gals.

To carry out this scheme of extensions, it would be necessary to construct a new basin for coagulation, using alum as the coagulant, and also a new filtered water reservoir at a higher elevation than the present one, so that water could be delivered under greater head to the proposed new pumping station. The scheme contemplates the use of the existing reservoir as at present, but only to store filtered water from the proposed slow sand beds.

It is claimed that the proposed new pumping station could be built to advantage to the southeast of the site of the proposed power station, between Halmfield Street and the aqueduct excavation. This location would eliminate further congestion at the present low level pumping station and would allow for future extensions, it is said, to greater advantage than the present site.

The filtration works were constructed under the general supervision of Paul E. Mercier, engineer of public works, and T. W. Lesage, engineer-superintendent of water works. Frederick E. Field is the assistant superintendent of water works; A. B. Reid, electrical and mechanical engineer; Allan Kilpatrick, chief filter operator; and J. H. Harrington, chief chemist. To Messrs. Field, Kilpatrick, Reid and Harrington, *The Canadian Engineer* is indebted for all of the above information, drawings and photographs.

PREPARATION OF SPECIFICATIONS FOR CONCRETE

Practical and Advantageous to Specify Concrete According to Strength or Any Other Quality Desired—Some Specifications Result in Unknown Factors of Safety

BY I. F. MORRISON
Assistant Professor of Structural Engineering, University of Alberta

THE problem of proportioning concrete is the subject of extensive investigations in many laboratories at the present time, and several well-known investigators have arrived at reliable results which have quite well determined the sound principles to be followed in the making and mixing of concrete. In fact, sufficient data and information are already available to enable almost any contractor to make good concrete of a required strength in a certain time, and more is being rapidly added to the great mass already accumulated.

In the field these methods are being put into practice with success, resulting in a uniformity of product, a certainty of results, and consequent economy. In most offices, however, where designs are being carried out in both plain and reinforced concrete, this is not the case. The reason is this: Specifications for the quality of concrete are not kept up-to-date and many designers are still calling for 1:2½:5 mixes for 500 lbs. per sq. in. concrete; 1:2:4 mix for 650 lbs. per sq. in.; 1:1½:3 for 750 lbs. per sq. in., etc., these being the allowable stresses at, say, 28 days. The factor of safety is relied upon to cover the deficiencies.

Now a 1:2:4 mix may or may not make a concrete good for the usually assumed 2,000 lbs. per sq. in. at 28 days. That depends upon several factors, including the quality of cement, quality and grading of fine and coarse aggregates, quantity of water and methods of mixing and handling; and, to any engineer who may read this, upon several of his own pet ideas on the subject, even upon the effect of the change in declination of Polaris.

Nevertheless, the above-mentioned factors are the most important, and most contractors realize their importance. The control of the work on any large job now-a-days is such that attention is given to all of these matters.

The designer in the office, however, is still plodding along, calling for a 1:2:4 mix—which is so antiquated as to be almost meaningless—when he uses a stress of 650 lbs. per sq. in. in his design. The result is that one job, or a part of it, has a factor of safety of, say, about 2, and the next, or a part of the same one, has a factor of safety of about 6 or 7. This is certainly not economy; furthermore, if additions or extensions are to be made in the future, how is one to tell whether the original factor of safety was 2 or 7?

This article is essentially addressed to the designer and the one who writes specifications in the office. If they are to make use of the methods and valuable information already acquired for mixing good concrete which is suited to the purpose, they must co-operate with the engineer and contractor in the field. After plans and specifications leave the office, it is too late to change materially the entire design; the damage is already done. It may be possible for the field engineer to produce 2,000 lbs. per sq. in. concrete, but it may not be economical. On the other hand, a contractor would certainly be living up to the specifications if he put in 1:2:4 concrete, as called for, whether it gave 1,000 or 3,000 lbs. per sq. in. at 28 days.

Now for the constructive part of this criticism:—

Specifications should call for concrete of a certain strength. The strength called for should be varied to suit the various purposes to which the material will be put, and an appropriate factor of safety should be used in the design. Available materials in the locality of the proposed work should be sampled and tested by a competent engineer, and, in order to make use of the information, the designer should be informed, as early as possible, as to the strength available from these materials.

In almost any locality tests on 6 by 12-in. cylinders can easily be carried out. There usually is not time to do this after the contract is let, but some weeks are usually spent in preparing the layouts preliminary to the actual design of the work, and it is during this time that the proposed testing should be carried out.

Even if it be too late to carry out such tests, a contractor can succeed in making a concrete of any reasonable desired strength if the matter be left entirely in his hands. There is considerable information always available to enable him to accomplish the working out of the proper proportions, and he should be required to present his proposed proportions to the inspector sufficiently early to permit a careful checking of them.

Several years ago such a method as is herein suggested would have been open to several objections. These objections to-day are not well founded. The method of specifying concrete according to the strength, or any other quality desired, has not only become extremely practical, but is more advantageous from the standpoint of economy to all concerned.

PUBLICATIONS RECEIVED

SAND AND GRAVEL IN ONTARIO.—By A. Ledoux. Report to the Ontario Bureau of Mines, published by the King's Printer of Ontario, 138 pages and paper cover, 6½ by 9½ ins., illustrated. The report reviews the characteristic properties of sand and gravel and methods of testing, and deals with the origin and occurrence of fragmental rocks, and the distribution of sand and gravel in Ontario. The several counties have been arranged alphabetically and the location of every described deposit has been indicated by township, concession and lot. Deposits in more than forty different counties were visited during four months of field work. The author states that this report should be considered as only preliminary, as it is desirable to make a large number of tests of mortars and concretes made from the materials sampled, and also to secure further chemical analyses.

A new power project in Manitoba, known as the Winnipeg River Power Co., has been organized, and the $7,000,000 plant proposed will require three years for completion. The site of the development will be Bonnet Falls, 75 miles northeast of Winnipeg. This plant will have an ultimate capacity of 168,000 h.p., in six units of 28,000 h.p. each. This will exceed the combined output at present of the municipal plant at Point du Bois and that of the railway company at Pinawa Channel.

The Dominion Bureau of Statistics, Ottawa, has just issued a directory of the chemical industries in Canada, listing the names, addresses and products of nearly 500 Canadian firms manufacturing chemicals or other products in which the processes used are essentially dependent upon the agency of chemical change.

The Dominion Iron & Steel Co., Ltd., Sydney, N.S., have accepted an amendment to their government contract for steel plate. The original contract was for 50,000 tons per year for a period of 5 years, at $4.15 per hundred pounds. This has been modified by mutual agreement to $3.65 per hundred pounds. This means a saving of approximately $2,500,000 to the government. The company will now complete the erection of the new mill at an approximate cost of $5,000,000.

THE COST OF A MILE OF ROAD*

By George A. Duren
State Highway Engineer of Texas

THE three diagrams herewith present the elemental facts pertaining to the cost of a mile of road. Fig. 1 shows transportation costs for motor vehicles for various grades and surfaces. Fig. 2 is based on facts as set forth in Fig. 1, to show the annual cost of a mile of road, including cost of maintenance, cost of traffic for varying costs per ton mile, and interest on the cost of construction. Fig 3 shows the cost per ton mile, including the transportation cost per

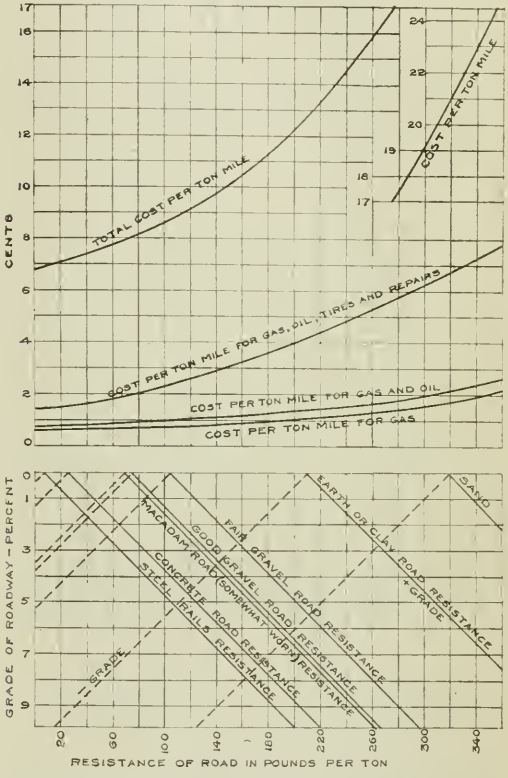
CENTS
TOTAL COST PER TON MILE
COST PER TON MILE
COST PER TON MILE FOR GAS, OIL, TIRES AND REPAIRS
COST PER TON MILE FOR GAS AND OIL
COST PER TON MILE FOR GAS
GRADE OF ROADWAY—PERCENT
EARTH OR CLAY ROAD RESISTANCE + GRADE
SAND
GOOD GRAVEL ROAD RESISTANCE
FAIR GRAVEL ROAD RESISTANCE
MACADAM ROAD (SOMEWHAT WORN) RESISTANCE
CONCRETE ROAD RESISTANCE
STEEL RAILS RESISTANCE
GRADE
RESISTANCE OF ROAD IN POUNDS PER TON

FIG. 1—TRANSPORTATION COSTS FOR MOTOR VEHICLES FOR VARIOUS GRADES AND SURFACES

ton mile paid by the user of the highway and the cost per ton mile of the highway itself, which is paid by the taxpayer in highway construction and maintenance.

All the highway authorities have been dealing with highway construction and maintenance almost solely in an effort to deal with this subject at the least possible cost on the part of the taxpayer, with little or no consideration for the cost of transportation.

The authorities agree that a 9-ft. gravel road is a satisfactory and economical highway for traffic not to exceed 200 vehicles per day, and that a 16-ft. gravel road is a satisfactory and enonomical highway for use of vehicles not to exceed 500 per day. Authorities differ concerning the automobile highway for traffic of from 500 to 1,000 vehicles per day, but the general opinion is that for this traffic some form of

*From a paper presented at an Engineering and Road Builders' Congress at Mineral Wells.

bituminous surface is most satisfactory. It is suggested that for traffic exceeding 500 vehicles per day and not exceeding 750 vehicles per day, a macadam road with bituminous surface treatment should be used; and for traffic exceeding 750 vehicles per day and not exceeding 1,000 vehicles per day, a substantially built asphalt macadam construction should be used. Traffic exceeding 1,000 vehicles per day

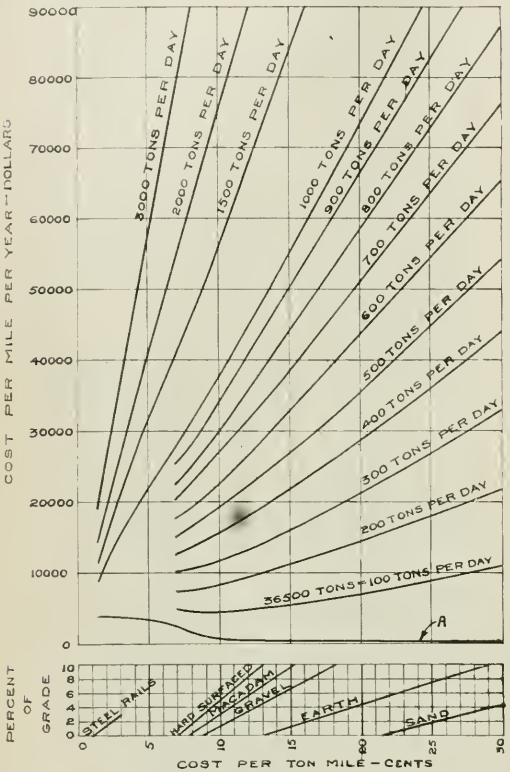

FIG. 2—ANNUAL COST OF A MILE OF ROAD, INCLUDING COST OF MAINTENANCE, COST OF TRAFFIC FOR VARIOUS SURFACES AND GRADES AND INTEREST ON CONSTRUCTION COST

Assuming interest at 5% per annum. Assuming initial cost per mile of concrete at $40,000; macadam, $20,000; gravel, $15,000; earth, $3,000; sand, $0. Assuming annual maintenance per mile of concrete at $400; macadam, $300; gravel, $300; earth, $200; sand, $0. Bottom curve (A) represents costs per annum of mile of roadway, including maintenance and interest on investment.

should be served with a concrete paving not less than 16 ft. wide. For traffic amounting to as much as 2,000 vehicles per day, a concrete pavement 20 ft. wide should be used, and for traffic exceeding 1,500 vehicles per day a brick pavement is desirable. Traffic exceeding 2,000 vehicles per day should be served with a pavement not less than 20 ft. wide and constructed with concrete foundation not less than 5 ins. thick, with brick, wood block, rock asphalt, sheet asphalt, granite block, or some form of asphaltic concrete not less than 2 ins. thick, should be used. These conclusions are probably in keeping with economy when viewed only by the cost of building and maintaining the highway under the varying intensities of traffic for units formerly used. All of these types of construction are such as will enable traffic such as formerly was found on the highways to continue 365 days a year. Traffic amounting to less than 50 vehicles per day has been provided for by earth roads, occasionally graded and dragged. Traffic amounting to 1, 5 or 10 vehicles per day has been accustomed to getting along the best it could over the natural surface of the ground.

The approximate costs of transportation are as follows: Upon an unimproved road, 30 cts. per ton mile; on an improved earth or sand-clay road, 25 cts. per ton mile; on a hard gravel road, 20 cts. per ton mile; on a bituminous surfaced gravel road, 15 cts. per ton mile; on a concrete or brick road, 10 cts. per ton mile.

Fig. 3 is based on more conservative assumptions, as follows:—

Cost per ton mile on 9 ft. gravel road, 22 cts.
Cost per ton mile on 16 ft. gravel road, 21 cts.
Cost per ton mile on 16 ft. bituminous road, 20 cts.
Cost per ton mile on 16 ft. asphalt macadam road, 19 cts.
Cost per ton mile on 9 ft. concrete road, 18 cts.
Cost per ton mile on 16 ft. concrete road, 17 cts.
Cost per ton mile on 16 ft. brick road, 16 cts.

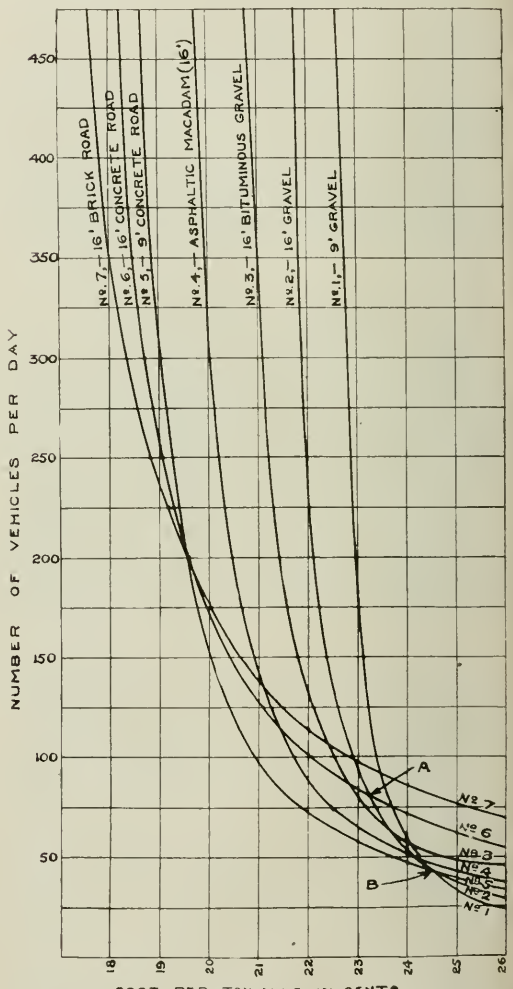

FIG. 3—TOTAL COST OF TRAFFIC PER TON MILE, INCLUDING TRANSPORTATION COSTS FOR VARIOUS TYPES OF SURFACES —SEE TABLE 1 FOR ASSUMPTIONS USED IN CALCULATING ABOVE CURVES

At point A. No. 2 equals No. 6, at 82¼ vehicles a day. At point B. No. 1 equals No. 5, at 43¼ vehicles a day.

The tonnage of traffic is assumed at one-half the number of vehicles, and the annual cost of the road assumed also is conservative and most favorable to the cheaper type of construction.

The cost of a road is essentially an annual cost. Man has not yet constructed any permanent structure and no highway has yet been constructed which, if it is used, does not require annual expenditure for maintenance. This rule applies to the Appian Way and every other road. We have not lost the art of road building, but we have lost the willingness to spend a sufficient amount of money on the road.

A permanent road is a road that is permanently maintained. The cost of a mile of road is the cost per mile of road per year. Too much attention is given to the original cost of construction and too little interest and attention is given to the cost of permanent service. A rational study of the cost of a mile of road must be arrived at by adding the interest on the original investment to the cost

TABLE 1—ASSUMPTIONS USED IN CALCULATING THE CURVES IN FIG. 3

Curve	Kind of Road	Cost of Surface only in Thousands of Dollars	Annual Maintenance*	Total Cost per Ton Mile (Dollars)
1....	9' Gravel	3	y	$(150+y)/182.5y+0.22$
2....	16' Gravel	5	$0.8y$	$(250+0.8y)/182.5y+0.21$
3....	16' Bit. Gravel	8	$0.6y$	$(400+0.6y)/182.5y+0.20$
4....	16' Asph. Mac.	9	$0.4y$	$(450+0.4y)/182.5y+0.19$
5....	9' Concrete	10	$0.2y$	$(500+0.2y)/182.5y+0.18$
6....	16' Concrete	18	$0.15y$	$(900+0.15y)/182.5y+0.17$
7....	16' Brick	25	$0.1y$	$(1,250+0.1y)/182.5y+0.16$

*y = number of vehicles a day (assumed to be ½ ton per vehicle).

of annual maintenance necessary to retain the original structure. This seems all that must be considered as a part of the cost of the road; however, the most important matter to be considered is the cost to the traffic using the highway as affected by the condition of the highway.

The use of the road occasions a cost to traffic amounting to a certain rate per ton mile. The improvement of the road is an economic waste unless a saving is effected by its expenditure as an investment in reducing the cost of the traffic using the road. The cost per mile of road per year should never exceed the reduction in the cost of transportation using said mile of road, made possible by the improvement.

E. H. Harriman is remembered as being a railway wizard as well as a financial genius. He took over unprofitable railways and bankrupt railways and spent millions of dollars on these losing ventures to improve the roadway, reducing the grades and laying heavier rail and building better track. He did not reduce the cost per mile per year of maintaining the track thereby, but he did reduce the cost per ton mile of all traffic using the road, thus transporting the tonnage at an enormous saving, which went into dividends. Yet he was able to accomplish only the small saving of approximately one-half of 1% per ton mile.

The seventeenth annual convention of the American Road Builders' Association will be held at Louisville, Ky., Feb. 9th to 13th, 1920. Both the sessions of the convention and the exhibition will be accommodated in the First Regiment Armory. About 53,000 sq. ft. of floor space will be available.

The United States Navy Department has just increased the pay of its technical employees. The force had been working for over seven months to obtain a greatly needed readjustment in compensation. Their case was handled through special wage boards at the navy yards and a department board.

Dr. C. J. Hastings, medical officer of health for the city of Toronto, favors the construction of another water works intake at that city, declaring that the supply should not be entirely dependent on one intake, as a serious situation might be created in case of certain accidents to the present system.

WATER WASTE CONTROL BY HOUSE INSPECTIONS WITH DISTRICT METERING*

By E. D. Case
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HOW to control waste of water in city distribution systems is a problem that is becoming of greater importance each year. The old idea that water should be as "free as air" is now obsolete. The increase in cost of extensions which are necessary if waste is not curtailed, due to high price of pipe, building material, labor, etc., has made it imperative that every water works manager who desires maximum efficiency in his plant, take steps not only to reduce waste to a minimum, but to make such a reduction permanent.

Water waste may be said to come under two general heads: (1)—Underground leakage; and (2)—House waste. While the first item exists to a greater or less extent in all water works systems, it is usually smaller by comparison to the second, especially in unmetered plants. The item of house waste may be further divided into three sub-heads:—(1)—Wilful waste; (2)—Leaking services; and (3)—Leaking fixtures.

Development of Deacon System

The most obvious and effective means of controlling waste of this kind is to place meters on all services. The owner will not run water for cooling purposes in summer, or allow his faucets to run continuously to prevent freezing in winter, if he knows that every cubic foot of water wasted will appear in dollars and cents on his next water bill. Furthermore, when paying for water on such a basis, he loses no time in repairing leaks in his fixtures or services as soon as they make themselves evident.

Unfortunately, however, local conditions make universal metering impossible in a great number of places. Either sentiment is against this method of selling water, or the first cost of installation is prohibitive and the manager must look about for some other method of controlling waste. Fortunately, there is one at hand which when properly applied will prove quite as effective as universal metering. This system may be described briefly as house-to-house inspections under the supervision of a district meter. It is by no means a new idea, as it is simply a development of the "Deacon Meter System," originated by George F. Deacon, engineer of the Liverpool (England) water works. The scheme in general at that time was as follows:—

New Portable Flow Meter

The distribution system was divided into districts by valve operation, and a meter especially designed for the purpose, called a "Deacon Meter," was placed in a vault on the main supplying each district with water. By cutting a block out of the district, or by shutting off the service, the amount of water used or wasted in this block, or through this service, was recorded by the meter. Inspectors were then sent into blocks where flows were abnormally high, and the cause of the high flow located and the leaks repaired.

This system was almost universally adopted throughout Great Britain, with the result that the per capita consumption in British cities at the present time is remarkably low. The accompanying table shows the per capita in some of the larger cities in Great Britain.

The "Deacon Meter System" was adopted by the city of Boston in 1881, with considerable success, but its use did not become very popular in the United States owing to the large cost involved in installing the district meters, also due to the fact that they deteriorated very rapidly and repairs and replacements were constantly needed, which made the cost of maintaining them very high. These drawbacks were overcome about 1900 by the development of a portable flow meter, called the "Pitometer," an application of the principle of the Pitot tube. Practically the same methods were used, but instead of permanently setting a

*From a paper read at a recent convention of the Southwestern Water Works Association.

large meter on the supply line to each district, all that was necessary with the portable instrument was to tap each supply line with a standard 1-in. corporation cock, and the flow meter was moved from one gauging point to another as the occasion demanded.

This system was first used in Terre Haute, Ind., in 1897, and later in Columbus, Ohio, in 1902. Since that time over 200 cities of the United States have adopted this method of controlling water waste, and from year to year the system has become more complete until at the present time its efficiency is unquestioned.

Probably the most successful results of recent years have been obtained in Trenton, N.J., and Buffalo, N.Y. In Trenton, the daily consumption had gradually increased from 9,000,000 gals. in 1902 to 21,000,000 gals. in 1913. This was partly due to increase in population and industrial use, but in most part was due to the fact that waste conditions were becoming greater as no steps were taken to curtail them. In 1914, when the population supplied was approximately 125,000, the "Pitometer system" of controlling water waste was installed, with the result that in a year's time the consumption had been reduced to 15,000,000 gals. a day. If nothing had been done to stop the waste, the consumption would have been about 27,000,000 gals. per day, based on the average rate of increase for the ten preceeding years. This means that by installing the system of waste control, a saving of $4.40 a day was made in coal alone. In addition, the need of a new reservoir and a new pump was put off indefinitely, together with the resulting necessity for larger mains. These extensions would have cost approximately $1,000,000. By repeating the district house-to-house inspections under the supervision of the "Pitometer," this reduction in waste has been made permanent up to the present time.

City.	Population.	Average per capita consumption, gallons daily.
Aberdeen	155,000	54.0
Ashton	140,000	24.0
Belfast	360,000	39.6
Birkenhead*	104,920	40.8
Birmingham*	775,502	33.6
Blackburn*	130,000	30.0
Bolton*	237,159	32.4
Bournemouth*	85,920	27.6
Bradford*	450,000	54.0
Bristol*	353,374	26.4
Cardiff*	190,000	30.0
Darlington	46,000	25.2
Derby*	129,500	26.4
Dublin*	333,300	43.2
Dundee*	202,000	60.0
Edinburgh*	435,500	49.6
Glasgow*	1,075,735	67.2
Halifax*	224,933	18.0
Leeds*	430,000	42.6
Liverpool*	850,000	37.7
London	6,304,653	40.8
Manchester*	1,082,000	34.8
Newcastle*	485,000	45.5
Northampton*	120,000	18.8
Nottingham*	301,000	24.0
Oldham*	223,000	27.0
Paisley*	101,000	83.2
Plymouth*	132,326	55.2
Portsmouth*	200,000	48.7
Rochdale	100,000	22.8
Sheffield*	429,552	32.4
S. Essex*	146,000	24.0
Stockport*	135,000	27.0
Stockton*	230,000	62.4
Swansea*	110,000	34.8
Wakefield*	138,000	21.6
Wolverhampton*	136,000	26.4
Grand average,		37.6

*Adjacent communities also supplied.

The results obtained by the city of Buffalo have been perhaps even more remarkable, inasmuch as it was necessary to carry on the work on a much larger scale than in Trenton. For a great many years Buffalo had the distinction of having the highest per capita consumption of any city in the United States. In 1917, just prior to the start of the water waste survey, about 180,000,000 gals. a day were being pumped into the mains, or a per capita of approximately 360 gals. In June, 1917, the "Pitometer system" of waste control was installed, and the daily consumption has now been reduced to about 120,000,000 gals. a day, or a per capita of 240 gals., although the first inspections have not been extended over the entire city. Of this amount, 100 gals. daily per capita are sold to the industrial consumers, leaving a domestic per capita of about 140 gals. This is still far in excess of the actual need of domestic consumers, but is being reduced day by day, and within the next year will undoubtedly reach a reasonable figure. What these results will mean to the city of Buffalo may be seen from the following facts:—

One Pumping Station Eliminated

The water is pumped from two pumping stations, each containing five 30,000,000-gal. pumps, with an approximate capacity of 150,000,000 gals. a day. The present daily pumpage is within the capacity of one station, and for the past six months only one pump has been in operation in the second station. When the margin of safety becomes a little greater, this station will be put into reserve and the entire load carried by one station. An enormous saving will result in operating costs.

For the purpose of the survey, the city was divided into ten sections and each section subdivided into a number of districts. The flow was then measured into each district by the "Pitometer," and further investigations made by subdividing each district at night, so that the rate of flow between each pair of valves was determined. Wherever this seemed excessively high, inspectors were sent into the blocks to locate and stop leaks. Each inspector was equipped with a blank form, which enables him to report the number, location and cause of all leaks discovered on the services or on the premises of consumers. Notices were left with the property owner, and a duplicate filed in the water works office, which required that the leaks be stopped within a designated number of days, with a penalty of shutting off the service in case repairs were not made. After re-inspections had been made to determine that all waste had been stopped, a remeasurement was made of the entire district and the results recorded. These results demonstrated the efficiency of this system.

Periodical Remeasurements

In order to discover the permanancy of the reduction in the various sections of the city, re-measurements were made of the flow in typical districts after periods of six, twelve and eighteen months had elapsed. In this way it was determined that in some sections of the city the waste had not returned in a sufficient amount to warrant reinspections until a period of eighteen months had elapsed. In other sections the investigations proved that in order to control waste, yearly inspections should be made; while in still other sections, notably those containing the poorer class of consumers, with exposed plumbing and anti-freezing toilets, inspections every six months, or even oftener, were necessary in order to control the waste.

In some cities it has been found practical to combine a system of selective metering with house-to-house inspections, which has been productive of even more satisfactory and permanent results. This system permits the metering of all wasteful commercial users of water, such as garages, livery stables, laundries, bakeries, saloons, etc., as well as metering the domestic consumer in cases where the officials are convinced, by repeated inspections, that this is the only way of compelling the owner to keep his plumbing in repair.

Probably a great many water works managers or superintendents will say that they have tried to reduce waste by house-to-house inspections, but that either no reduction in the daily consumption has resulted, or what reduction has occurred has not been sufficient to be of any practical value. This was the situation in nearly all of the unmetered cities where the "Pitometer system" has been introduced in the past twenty years. It is a matter of interest to note that inspections had been carried on for a number of years previous to the installation of this system in Buffalo, but in spite of that fact, the consumption was gradually increasing each year. The same force which had been employed in carrying on this work was used in making the systematic inspections under the supervision of the "Pitometer," and the increase in the efficiency of the inspections is well demonstrated by the results obtained. The reason is easily explained:—

Efficiency of Work Increased

When the inspections are made under the supervision of the "Pitometer," the inspector knows the amount of waste in each block before he starts his inspections. He also knows that there will be a remeasurement after repairs have been made, and if the flow has not been reduced to a satisfactory amount, further inspections will have to be made. This arouses his personal interest and enthusiasm, and the efficiency and thoroughness of his work increases correspondingly.

All Must Curtail Waste

Every city of Canada and the United States where the consumption figures show the existence of water waste, must some day take steps to curtail this waste. The leaks will not stop of themselves, and it is not only uneconomical and impractical to continue to install new pumps, build new reservoirs and lay new mains, but in many cases it is impossible on account of insufficient supply.

The fact that a city or town has an inexhaustible water supply, as is the case of those situated on lakes or rivers, is no reason for allowing waste to exist. No matter what the conditions are, it can only be brought to the consumer at considerable expense, and it is inexcusable to permit the waste of water on this account when such waste can be eliminated and controlled at a nominal expense.

Hopeless if Too Late

The fact cannot be emphasized too strongly that when the city is actually facing a water shortage, it is usually too late to save the situation by reducing the waste. It is then almost invariably necessary to install the new pump, to build the new reservoir or to lay the new main, thereby burdening the city with a much greater expenditure. The far-seeing water works manager or superintendent will never allow conditions in his plant to reach this point, when they may be avoided by comparatively small expense and effort on his part.

A very curious situation was brought to light some years ago in a large office building, where an apparently excessive consumption caused the water officials to attach a meter to the service pipe for the purpose of arriving at a suitable charge. It was hardly to be believed, but the registration by the meter showed that more water was being consumed at night, when the building was empty save for the janitor and family, than during the day, with all the suites occupied and water being freely used by all. A careful investigation was made, and it was found that all the toilets were fitted with a very poorly-constructed ball-cock fixture, which became disarranged every night by the increased pressure in the mains. This allowed a steady flow from the tanks, down the waste pipes, that lasted throughout the entire night all over the building until the day usage again reduced the pressure. Naturally, the owners of the building had a heavy water bill, but, needless to say, the wasteful fixtures were speedily replaced by others of a better kind and this ususual and costly source of waste was closed.

PROPORTIONING OF PIT-RUN GRAVEL FOR CONCRETE*

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THE factors upon which the strength of concrete must depend are (1) the density of the concrete, and (2) the extent to which the particles are cemented together. The latter factor depends upon the amount of cement in a given volume, and upon the total surface area of the particles.

Table I.—Ratio of Cement to Aggregate Constant

Per cent of "Sand" in Aggregate, by Weight.	Proportions (1:5).	Density.	Water, per cent of dry materials.	Compressive Strength, lb. per sq. in.
42	1:2:3	0 789	9 33	1600
55	1:2 3/4 : 2 1/4	0 770	10 65	1200
75	1:3 3/4 : 1 1/4	0 737	12 65	920
95	1:4 3/4 : 1/4	0 673	15 30	480

Inasmuch as numerous authorities are agreed that the density of the mixture is partly and the surface area wholly dependent upon the grading of the aggregate, and that the density also depends upon the consistency, or amount of water in the mixture, the writer has formulated for his own use the following rule for proportioning concrete mixtures:—

Use the best graded aggregate available, enough cement to make concrete of the class desired, and mix with the least amount of water which will yield a workable mixture for the conditions under which the concrete is to be placed.

Table II.—Physical Characteristics of Aggregates Used

Sand No.	Pebbles No.	Percentage of Voids, Loose.	Loose Weight, lb. per cu. ft.	Percentage of Silt.	Specific Gravity.	Sieve Analysis: Per cent Passing Sieve No.					
						4	8	14	28	48	100
						Size of Opening, in.					
						1 5	0 75	0 371	0 185	0 093	0 046	0 023	0 0117	0 0058
1		39 8	99 9	4 0						100.0	67 5	25 5	6 5	1 5
2		39 3	100 7	2 0						100 0	83 5	57.0	18 5	4 5
3		42 2	95.9	9 0						100.0	72 5	37.0	12 0	7 0
4		37 9	103 0	2 0						100 0	82 0	49.5	10 0	3 8
5		40 5	98 4	4 0					100 0	82.0	58 0	23.6	5 8	1 5
6				1 3					100 0	87 0	69 5	45 2	18 0	2 0
7		45 0	91 3	7.5					100 0	79 8	55 3	28 2	10.0	3.8
8		39 7	90 8	0 8					100 0	85 2	66 5	39 4	6 2	0.3
11		41 2	98.8	2 0	2 68					100.0	87.6	43 2	11 1	1 3
12		41 3	101 1	1 8	2 75				100 0	96.4	60.1	32 9	18 2	3 8
13		42 0	99 1	1 8	2 73					100.0	78.6	39.3	9 7	1 8
15		41 2	98 7	2 0	2 69				100 0	85.2	59.7	31 6	8 6	1 2
16		39.3	104 4	1 6	2 75			100 0	92 8	61 5	35.2	17.9	9 7	2.1
17		42.3	98 5	1 5	2 72			100 0	98 0	83 9	61.3	30.8	7 4	1 6
20		40.0	100 0	2 0	2 68			100 0	99 1	87.7	63.7	33.7	9 1	2 1
21		37 7	103.8		2 68			100.0	99 4	87 3	59 8	31.5	10 2	2 1
	9	37.5	103 7	0.0		100.0	89 7	52 8	29.8	1 9				
	10	41 6	98 1	0 0		100.0	84 5	24 2	3 7	0.8				
	18	42 4	102 3	0 0	2.81	100.0	86 9	49 2	27.9	8 4				
	19	42 4	100.0	0 6	2.82	100 0	74 8	31 7	10 3					
	22	42 2	101 0	1 5	2.80		100 0	82.5	31.5	1 6				
	23	37 4	103.5	1 0	2 65	100.0	64 9	52.5	12.7	1.1				

The material to be considered in this paper is pit-run gravel, to be used without change as it comes from the pit. The problem is to establish some relation between grading and the amount of cement such that, for mixtures of the

*Paper read at the annual meeting of the American Society for Testing Materials, June 24th to 27th, 1919.

same plastic consistency, concretes of equivalent strength could be designed.

To establish such a workable relation, it is necessary to express the grading of the gravel by numerical functions. Other experimenters, notably Abrams and Edwards, have done so, and their work could be used as a basis for proportioning pit-run materials. However, both Abrams' "Fineness Modulus" and Edwards' "Surface Area" method require the making of a complete sieve analysis of the material. The method herein described requires the separation of a sample into only two sizes and a simple determination of the weight per cubic foot of the loose gravel.

The principal conclusion resulting from the investigation carried out is that the grading of pit-run gravel may be measured by the ratio of fine aggregate to total aggregate (that is, percentage of fine aggregate in total) and by the weight per cubic foot of the material, measured loose. For purposes of commercial convenience the dividing line between fine and coarse aggregate is taken on the common No. 4 sieve. In the following discussion, fine aggregate as defined above will be called "sand," and coarse aggregate "pebbles."

Two assumptions have often been made by users in proportioning the cement to pit-run gravels:—

1. That the ratio of cement to total aggregate should be a constant.

2. That the ratio of cement to the sand portion of the aggregate should be a constant.

The former is wrong and on the unsafe side. The latter is also wrong but is on the side of safety.

Cement to Aggregate Constant

Table I. is typical of the strength of concretes made under the assumption that the ratio of cement to total aggregate should be kept constant. Further demonstration of the fallacy of this assumption is not necessary.

Cement to Sand Constant

The assumption that the ratio of cement to percentage of sand in the gravel should be a constant was investigated in twenty-four series of tests. Materials from several localities and two classes of concrete were used. Table II. gives physical characteristics of the aggregates used in the investigations described herein.

Each series comprised tests of gravels containing respectively 42, 55, 75 and 95 per cent. by weight, of sand. The mixtures were made arbitrarily by combining sand and pebbles in the right amounts. The same sand and pebbles were used in each mixture in a series. Each series included tests of forty specimens. Five specimens were broken for each test of a mixture. Specimens from all series were tested at 28 days old; specimens from some series were tested at 7 days and from others at 6 months. Specimens were 8 by 16-in. or 6 by 12-in. cylinders stored in water.

In some of the series the No. 8 sieve was taken as the dividing line between sand and pebbles. The general result was very similar to that obtained with the No. 4 sieve.

In Table III. are given typical results of these tests for three series, showing the variation in strength of concrete with the percentage of sand in the gravel, when the ratio of cement to sand is kept constant. The strength increases with the percentage of sand in every mixture in the table, save one, and the results are typical of all series.

Obviously, neither the ratio of cement to total aggregate, nor the ratio of cement to the sand portion, should be a constant, but for equivalent mixtures the ratio of cement to total aggregate should increase in some relation to the percentage of sand in the gravel. That this is a straight line relation is demonstrated as follows:—

TABLE III.—VARIATION IN COMPRESSIVE STRENGTH OF CONCRETE WITH THE PERCENTAGE OF SAND IN THE GRAVEL, WHEN THE RATIO OF CEMENT TO THE SAND PORTION OF THE GRAVEL IS KEPT CONSTANT

CEMENT TO SAND = 1:2 BY WEIGHT.

CLASS 1—SAND PASSING SIEVE NO. 4—PEBBLES RETAINED ON SIEVE NO. 4 AND PASSING 1½ IN. SIEVE

Series No.	Sand No.	Proportions: Weight. Cement to Aggregate.	Weight. Sand to Pebbles.	Loose Volume. Cement to Aggregate.	Loose Volume. Sand to Pebbles.	Loose Volume. Computed for Equivalent Strength.	Absolute Volume. As Used.	Absolute Volume. Computed for Equivalent Strength.	Weight, lb. per cu ft. Aggregate.	Weight, lb. per cu ft. Green Concrete.	Absolute Volume: Parts of Unit Volume in Green Concrete. Cement (c).	Sand (s).	Pebbles (p).	$c+\frac{1}{4}p$ = Density.	Water in Mix, by Weight. Percentage.	Compressive Strength, lb. per sq. in. Age, 7 Days.	Age, 28 Days.
5	5	1:4 75	42:58	1:3 9	48:66	1:4 05	1:5 5	1:5 5	112 0	147 6	0 121	0 284	0 379	0 784	10 9	1235	1864
		1:3 66	55:45	1:3.2	62:51	1:4 1	1:4 3	1:5 5	110 2	149 0	0.148	0 346	0 292	0.786	11.2	1438	2275
		1:2 66	75:25	1:2 3	82:27	1:3 35	1:3 1	1:4 35	107 1	147 2	0 182	0 426	0 142	0.750	13 9	1637	2826
		1:2 10	95:5	1:2	97:5 1	1:3 2	1:2 5	1:3 9	100 1	146 1	0 209	0 493	0 030	0.732	14 8	2244	3532
6	6	1:4 75	42:58	1:3 8	48:68	1:3 9	1:5 4	1:5 4	114 8	146 1	0 122	0 279	0.383	0.784	9 8	1872	3360
		1:3 66	55:45	1:3 1	62:52	1:3 7	1:4 4	1:5 1	112 35	146 1	0 144	0.340	0 291	0 775	10 4	1792	3296
		1:2 66	75:25	1:2 3	80:27	1:2 7	1:3 1	1:3 6	107 1	141:2	0 175	0 408	0.137	0 720	13.2	2120	3452
		1:2.10	95:5	1:2	96:5 2	1:2 7	1:2 5	1:3 35	101 1	141 8	0 206	0 482	0.024	0.712	14 5	2360	3864
7	7	1:4.75	42:58	1:3 9	51:66	1:4 15	1:5 6	1:5.6	111 3	146 1	0.116	0 272	0.382	0.770	11 85	1150	2340
		1:3 66	55:45	1:3 2	63:49	1:4 05	1:4 25	1:5 3	107 8	145.6	0.145	0.339	0.276	0.760	12.1	1423	2872
		1:2 66	75:25	1:2 4	84:26	1:3.3	1:3 1	1:4 1	102.3	143 0	0 175	0.410	0.136	0.721	15 0	1550	3245
		1:2 10	95:5	1:2 1	98:4 6	1:3 35	1:2 5	1:3 8	94 0	142 0	0 204	0 480	0 024	0.708	15.3	2045	3680

The "Sand" Method

The "sand" method of making concretes of equivalent strength, using gravels of varying sand content, depends upon the assumption that there is a direct relation between the strength of concrete and the ratio

$$c/[1-(c+s+p)] = c/(1-d),$$

in which c = absolute volume of cement, s = absolute volume of sand particles, and p = absolute volume of pebbles in a unit volume of freshly made concrete; d = coefficient of density = absolute volume of solid material in a unit volume of freshly made concrete = $c+s+p$; and $1-d$ = volume of air and water voids.

DATA CONCERNING PROPORTIONS FROM TYPICAL SERIES

Per cent of Sand in Aggregate, by Weight.	c	s	p	d	$\frac{c}{1-d}$
33	0 096	0 227	0 440	0 763	.....
42	0 105	0 286	0 378	0 769	0 456
55	0 122	0 361	0 282	0.765	. .
75	0 132	0 456	0.145	0.733	. .
95	0 167	0 525	0.026	0 718	. . .

By absolute volume of a granular material is meant the actual sum of the volumes of all the particles; it is expressed as the fractional part of the total space occupied by the material.

The quantities are computed as shown in Taylor and Thompson's "Treatise on Concrete."

Fig. 1 demonstrates the truth of the assumption that, other things being equal, the strength varies with $c/(1-d)$.

The tests grouped on this diagram are comparable by reason of being made from the same cement, similar materials, and subjected to the same conditions as to making, molding and curing. Each point is derived from the average tests of five specimens. Diagrams of other groups of tests comparable among themselves give similar results. A similar diagram published in the last (1918) edition of Johnson's "Materials of Construction," computed from data published in U.S. Bureau of Standards Technologic Paper No. 58, corroborates this assumption.

In order to compute proportions for equivalent strength, it is necessary to assume for each class of concrete that some mixture is satisfactory. For the three classes of concrete considered in this paper, the following mixtures were taken as the basis:—

Class I.—Proportion 1: 4½, gravel containing 42 per cent. sand.

Class II.—Proportion 1: 5½, gravel containing 42 per cent. sand.

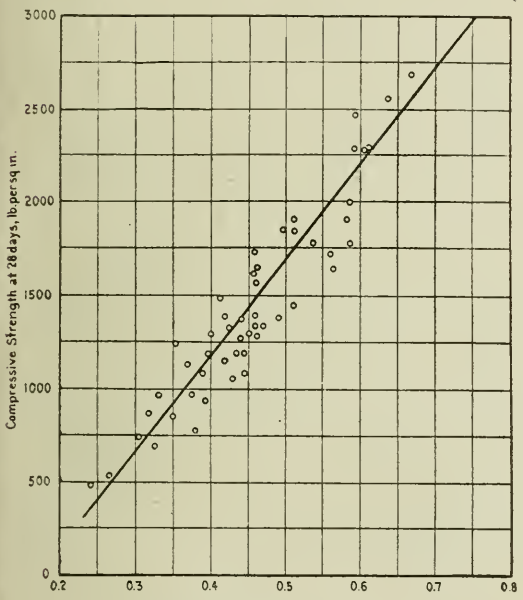

FIG. 1.—RELATION BETWEEN COMPRESSIVE STRENGTH OF CONCRETE AND THE RATIO $c/(1-d)$

c = Absolute Volume of Cement and (1—d) = Volume of Air and Water Voids in a Unit Volume.

Class III.—Proportion 1: 7, gravel containing 42 per cent. sand.

Taking each series of tests by itself, the probable proportions to use with the different percentages of sand in the aggregate, to yield concrete equivalent to the one having 42 per cent. of sand in the aggregate were derived as follows:—

To arrange the proportions for equivalent strength it is necessary to so change the relation between the absolute volumes of cement and aggregate that the ratio $c/(1-d)$ will, in each case, become equal to 0.455. The adjustment can be made by increasing or decreasing c and decreasing or increasing $s+p$, so that d will be unchanged, thus:—

Let c', s' and p' be the new values required for c, s and p, respectively. As explained above, these values are the percentages of absolute volumes of the materials in a unit volume of freshly made concrete.

$$c'/(1-d) = c'/[1-(c'+s'+p')] = 0.455$$

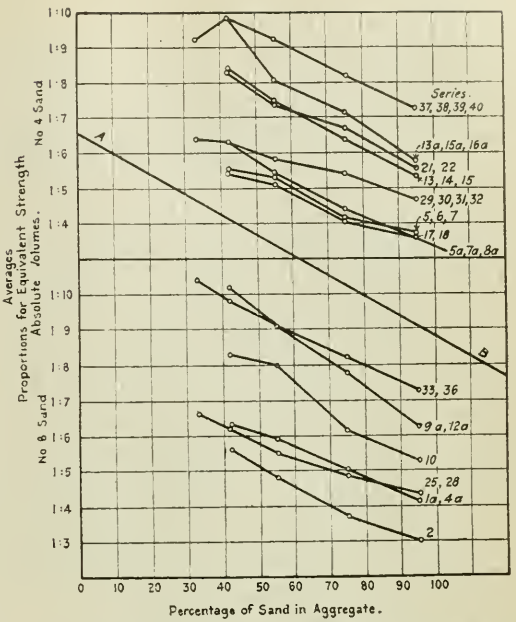

FIG. 2.—RELATION BETWEEN PERCENTAGE OF SAND IN GRAVEL, AND THEORETICAL PROPORTIONS BY ABSOLUTE VOLUME, NECESSARY TO YIELD CONCRETE EQUIVALENT TO A GIVEN BASE MIXTURE

Therefore, to convert the mixture containing 33 per cent. of sand:—

$$\begin{aligned} c'/(1-0.763) &= 0.455 \\ c' &= 0.108 \\ d &= c'+s'+p' \\ 0.763 &= 0.108+(s'+p') \\ (s'+p') &= 0.655 \end{aligned}$$

Accordingly the ratio of absolute volume of cement to absolute volume of total aggregate, required to make a proportion using the 33-per-cent. sand mixture equivalent to the 42-per-cent. sand mixture is 108: 655, or 1: 67.

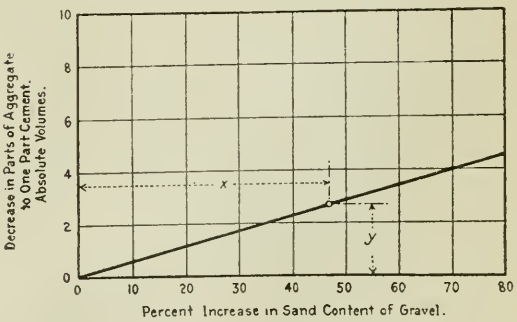

FIG. 3

To determine the amount of cement to use with a given pit-run gravel to yield a concrete equivalent to a given mixture of sand and gravel:

1. Reduce the proportion of the standard mix to the basis of absolute volume.
2. Determine from curve decrease in parts of aggregate corresponding to increase in percentage of sand in aggregate.
3. Change the absolute volume proportions thus found to the loose volume basis.

Formula for computing Item 2.

$\tan \alpha = 3.6/62 = 0.058$ (See A B, Fig. 2)

$y = x \tan \alpha = 0.058\ x$

New proportions for the 55, 75 and 95-per-cent. mixtures were computed in the same way.

This theory is approximate, not rigorous, for when the concrete is actually made, the density d will be affected a small amount. The result obtained, however, is within the probable range of accuracy in making the concrete.

The proportions thus derived are by absolute volumes. To make these proportions usable it is necessary to convert them to a loose volume basis, which requires the weight per

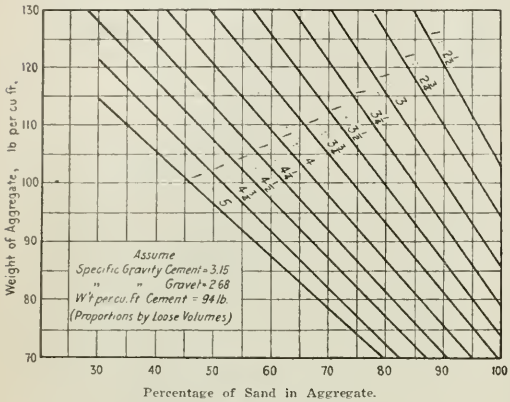
Weight of Aggregate, lb per cu ft.
Percentage of Sand in Aggregate.
Assume
Specific Gravity Cement = 3.15
" " Gravel = 2.68
Wt per cu. Ft Cement = 94 lb.
(Proportions by Loose Volumes)

Fig. 4—Diagram for Use in Proportioning Pit-Run Gravel for Class I. Concrete

cubic foot of cement and loose aggregate. Assuming cement to weigh 94 lbs. per cu. ft., its specific gravity = 3.14, and that of the aggregate = 2.68, absolute volume proportion of aggregate (cement = 1) may be changed to loose volume proportion by the following equation: Aggregate (loose) equals aggregate (absolute) multiplied by 80 and divided by the weight per cu. ft. of aggregate (loose).

In this way the absolute proportions and loose volume proportions of materials to yield concrete equivalent in strength to the one in each series whose aggregate contained 42 per cent. of sand, was determined for aggregates containing 33, 55, 75 and 95 per cent. of sand.

In Fig. 2 the relation between the proportions for equivalent strength by absolute volume and percentage of

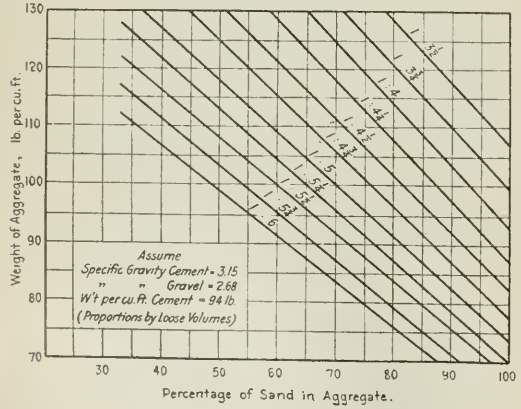
Weight of Aggregate, lb. per cu. ft.
Percentage of Sand in Aggregate.
Assume
Specific Gravity Cement = 3.15
" " Gravel = 2.68
Wt per cu. Ft. Cement = 94 lb.
(Proportions by Loose Volumes)

Fig. 5—Diagram for Use in Proportioning Pit-Run Gravel for Class II. Concrete

sand in aggregate is shown for all of the specimens tested. Each line is the average of results from 3 or 4 different sands, and, therefore, represents the conclusion drawn from 3 or 4 series of tests. Each point is the average of from 75 to 100 individual specimens.

The conclusion drawn from a study of this diagram is this: The relation between proportions by absolute volumes to give equivalent strength, and sand content of the aggregate, varies uniformly and at approximately the same rate for all degrees of quality of concrete. The line AB in the diagram is established to indicate this rate of variation as an average.

To make use of this diagram to determine the proportions to use with a given material having a certain sand content, it is necessary first to assume an aggregate and proportion known to be satisfactory. Locate the point representing this known condition and draw a line through it parallel to AB. Then pick from this line of proportions the proportion corresponding to the given aggregate.

To make a single line diagram of general application, the line AB (Fig. 2) is plotted on Fig. 3, using for ordinates the decrease in parts of aggregate, and for abscissas the increase in percentage of sand in the aggregate. This diagram can be used for determining proportions in a case when the proper data are at hand, or for writing a table of proportions for equivalent mixtures of cement and pit-run gravels in general. Such a table could not be exact for all materials, but it would give a very reasonable set of proportions to use with Iowa gravels.

Example: Assume that an aggregate containing 42 per cent. of sand, and weighing 112 lbs. per cu. ft., makes a satisfactory concrete in the proportion 1:4½ loose volume.

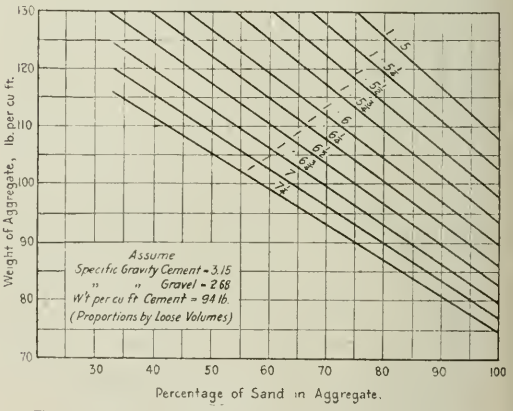
Weight of Aggregate, lb. per cu ft.
Percentage of Sand in Aggregate.
Assume
Specific Gravity Cement = 3.15
" " Gravel = 2.68
Wt per cu ft Cement = 94 lb.
(Proportions by Loose Volumes)

Fig. 6—Diagram for Use in Proportioning Pit-Run Gravel for Class III. Concrete

What proportion should be used with a similar gravel containing 75 per cent. of sand and weighing 107.1 lb. per cu. ft?

Change the proportion 1:4½ to a proportion by absolute volume, thus:—

$4.5 \times 112/80 = 6.3$. Proportion (absolute) = 1: 6.3.

The increase in percentage of sand is 33. From Fig. 3 the corresponding decrease in parts of aggregate is 1.9. 6.3—1.9 = 4.4. Therefore, the proportion for the aggregate containing 75 per cent. sand should be 1: 4.4, absolute volumes, or 1: 3.3 loose volumes.

Fig. 3 is perfectly general and can be used for designing mixtures equivalent to any assumed base.

The diagrams in Figs 4, 5 and 6 have been arranged for convenience in proportioning pit-run gravels for three classes of concrete:—

Class I., suitable for reinforced concrete in general, water-tight concrete, and base course of concrete pavement. It should range in strength from 2,400 to 3,000 lbs. per sq. in.

Class II., suitable for first-class foundations, gravity section piers and abutments for bridges, and base course of non-reinforced floors and walks. It should range in strength from 1,800 to 2,400 lbs. per sq. in.

Class III., suitable for large foundations and heavy mass work in general. It should range in strength from 1,200 to 1,800 lbs. per sq. in.

Verification

Table IV. shows the resulting strengths of laboratory specimens made in accordance with the foregoing principles. It is believed that these results verify the reasonableness of the method of proportioining pit-run gravels described. Series Nos. 48, 49 and 50 were made about one year after Series Nos. 46 and 47 from different materials, and by a different operator. The consistency was approximately the same in both groups.

Fig. 7, compiled from the averages of numerous tests of various materials and classes of concrete, illustrates in

TABLE IV.—PIT-RUN GRAVEL CONCRETE PROPORTIONED BY THE SAND METHOD

Concrete Class	Series No.	Material.	Characteristics, Mixed Aggregate. Percentage of Sand.	Weight, lb. per cu. ft.	Fineness Modulus.	Surface Area, sq. ft. per 100 lb.	Proportions. By Weight.	By Absolute Volume.	By Loose Volume.	c / 1−d	Percentage of Water in Mix, by Weight.	Compressive Strength at 28 days, lb. per sq. in.
I	48	Pebble, No. 23	33	113 9	533	819	1:6 06	1:6.6	1:5	0.374	10 0	1479
			42	114.7	501	978	1:5 49	1:5.92	1:4.5	0 414	10 0	1945
			55	117.5	458	1220	1:4 97	1:5.87	1:4 0	0.403	10.6	2425
			65	115.7	424	1398	1:4.61	1:5 0	1:3 75	0 426	10 3	2465
			75	113 6	392	1575	1:4 23	1:4 60	1:3 5	0 428	10.9	2585
			85	109.3	360	1753	1:3 76	1 4.10	1:3 25	0 433	11 3	2580
			95	106 9	327	1931	1:3 41	1:3.7	1.3	0 434	12.3	2160
II	49	Sand, No. 21;	33	113 9	533	819	1:7 27	1:7 90	1:6	0.308	10.1	1343
			42	114 7	501	978	1:6 71	1:7 28	1:5.5	0 340	9.6	1920
			55	117.5	458	1220	1:6.25	1:6 79	1:5.0	0.343	10.2	1800
			65	115 7	424	1398	1:5.54	1:6 01	1:4 5	0.363	10 3	1955
			75	113.6	392	1575	1:5 14	1:5 58	1:4.25	0.367	10.6	2135
			85	109 3	360	1753	1:4 85	1:5 06	1:4	0 356	11.7	2005
			95	106 9	327	1931	1:4.26	1:4 63	1:3 75	0.373	12 4	1860
III	50	Sand, No. 22.	33	113 9	533	819	1:8 78	1:9 52	1:7 25	0 269	9 4	1113
			42	114 7	501	978	1:8 54	1:9 26	1:7 0	0 284	9 5	1318
			55	117.5	458	1220	1:8 13	1:8 82	1:6.5	0.270	9.9	1415
			65	115.7	424	1398	1:7 38	1:8.14	1:6	0 287	10.1	1416
			75	113.6	392	1575	1:6 95	1:7.54	1:5.75	0.263	11.2	1925
			85	109 3	360	1753	1:6 40	1:6 93	1:5.5	0 263	12.3	1059
			95	106 9	327	1931	1:5 87	1:6.36	1:5.0	0.260	13.7	1031
I	46	Pebble, No. 22.	33	115 6	494	756	1:6.15	1:6.8	1:5	0.447	8.8	3120
			42	115.0	468	915	1:5 50	1:6.3	1:4.5	0.490	8.6	3290
			55	114 4	431	1142	1:4 87	1:5.53	1:4.0	0.536	8.8	3260
			75	112.5	374	1495	1:4 16	1:4.73	1:3.5	0.602	9.3	2970
			96	102.5	320	1839	1:3 27	1:3 8	1:3	0.604	10.8	3090
III	47	Sand, No. 20.	33	115.6	494	756	1:9.22	1:10.3	1:7.5	0.231	7.7	2000
			42	115.0	468	915	1:8.56	1:9.7	1:7.0	0.293	9.1	1810
			55	114 4	431	1142	1:7.91	1:9 0	1:6.5	0.316	9.25	1950
			75	112.5	374	1495	1:6 88	1:8 0	1:5.75	0 334	10.6	1580
			95	102.5	320	1839	1:5.45	1:6.3	1:5.0	0 371	11.0	1760

general the decrease in strength when the ratio of cement to total aggregate is made a constant, the increase in strength when the ratio of cement to sand portion of aggregate is constant, and the equivalent strength when the mixtures are proportioned according to the foregoing method.

The writer expects further to verify the method by making and testing field samples from a large number of jobs on which such material is used.

Application

The mere fact that pit-run gravel is ordinarily not a well-graded material, is not an insuperable obstacle to its use. All that is required is its use with the right amounts of cement and water. The principal difficulty is the fact that the product of a pit is often extremely variable as regards grading. Nevertheless, large amounts of this material are being used, and since in many cases great economy results from its use, it would seem that engineers should be prepared to lay down rules for the proper handling of this material.

This investigation was undertaken by the Engineering Experiment Station of the Iowa State College, at the request of the Iowa State Highway Commission, and their

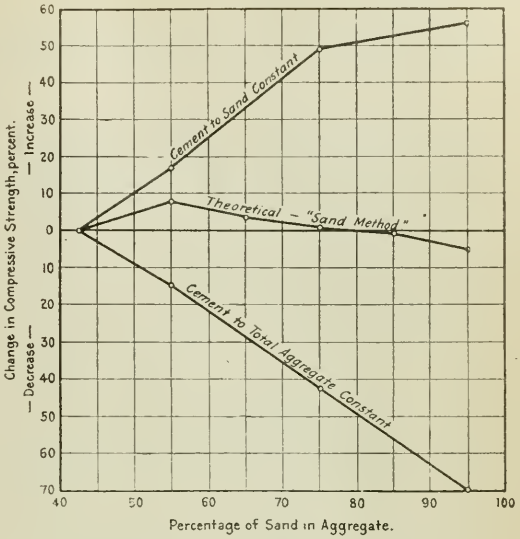
Change in Compressive Strength, percent.
— Increase —
— Decrease —
Cement to Sand Constant
Theoretical — "Sand Method"
Cement to Total Aggregate Constant
Percentage of Sand in Aggregate.

FIG. 7.—VARIATION IN STRENGTH OF GRAVEL CONCRETE, WHEN PROPORTIONED BY FOLLOWING THREE METHODS:—

(a) Cement to Total Aggregate Constant,
(b) Cement to Sand Constant,
(c) The Sand Method for Equivalent Mixtures.

present specifications for the use of pit-run gravel are based upon this work.

An important advantage of the method of proportioning described in this paper is the simplicity of the field tests required. The percentage of fine aggregate (or sand) in the

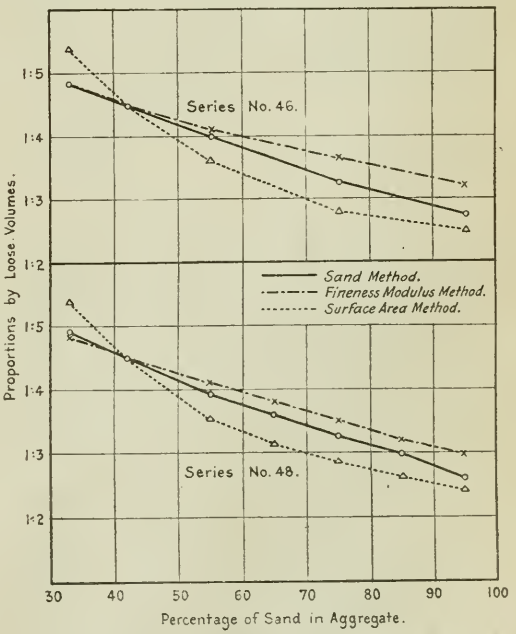

FIG. 8—RELATION BETWEEN THREE METHODS FOR DERIVING PROPORTIONS TO YIELD CONCRETE OF EQUIVALENT STRENGTH, "FINENESS MODULUS," "SURFACE AREA," AND THE "SAND" METHODS

gravel, and the weight per cubic foot, can easily be determined with simple apparatus.

In practical use, frequent analysis must be made and the proportions changed as often as is necessary to agree with the variations in the material.

Comparison With Other Methods

Fig. 8 shows a comparison between three methods of proportioning pit-run gravels to produce concrete of equivalent strength, the "Sand" method, as described in this paper, the "Fineness Modulus" method of Abrams, and the "Surface Area" method of Edwards. The proportions necessary to use with gravels containing various percentages of sand, to make concrete equivalent in strength to that of a 1: 4½ mixture in which the gravel contained 42 per cent. of sand, were computed by each method. The materials, and approximately the mixtures, are those shown in Table IV.

The proportions shown on this diagram are the theoretical mixtures as computed. In the greatest number of instances in which this material is used, it will not be practicable to state the proportions any closer than the nearest half or quarter part of aggregate. When the proportions in the diagram are changed so that the parts of aggregate to one part of cement conform to the nearest quarter part, it will be found that there is very little difference between the "Sand" and "Fineness Modulus" methods. The "Surface Area" method appears to call for somewhat richer mixtures.

LETTER TO THE EDITOR—CORRECTION

Sir,—We are very pleased with the notice given our penetration dial in your issue of July 10th, but wish to call your attention to an error in connection therewith. While it is true that the idea of advocating concordant action in specifying the penetration of asphalt for the various types of pavement made with that material, where traffic conditions and climate are the same, was indicated by the paper I prepared for the last convention of the A.S.M.I. at Buffalo, in October, 1918, nevertheless the idea of the dial belongs to our chief chemist, Leroy M. Law. Accordingly, I feel that you should not credit me with a creation which is the result of the skill and ingenuity of another.

J. R. DRANEY,
General Sales Manager,
U. S. Asphalt Refining Co.

New York City, July 14th, 1919.

JAPANESE WATER POWER SURVEY

THE value of water power as an indispensable adjunct to industrial development is being universally recognized. Japan has lately set aside a sum equivalent to over $400,000 for the investigation of sites for hydro-electric power plants and for the collection of reliable data for use in connection with future hydro-electric undertakings in that country. The programme of work includes the selection of 635 power sites; the only sites to be surveyed at present are those where more than 1,000 h.p. can be obtained by economical exploitation. There is also provision for the establishment of numerous stream-gauging stations and of new meteorological observatories. This work is to be completed by the end of next September.

Canada is justly proud of her water power resources, both latent and developed, and, in this connection, it is of interest to note the progress made in Japan. Hydro-electric plants in that country already utilize more than 1,000,000 h.p., and a further 2,000,000 h.p. is under lease for development. Construction work for about one-half of the latter quantity is now being proceeded with, and it is estimated that some 5,000,000 h.p. is capable of development on commercial lines. In Canada, the total hydro-electric power developed is over 1,800,000 h.p.—By L. G. Denis, writing in "Conservation," an official journal published by the Commission of Conservation, Ottawa.

TNT AS A BLASTING EXPLOSIVE

By Charles E. Munroe and Spencer P. Howell
Bureau of Mines, Washington, D.C.

TRINITROTOLUENE is an explosive which is obtained by acting upon toluene with nitric acid in the presence of sulphuric acid. Toluene is a liquid substance which is produced from soft coal in the process of making coke, coal gas and coal tar, and it is recovered for use from both the gas and the tar. It is also made in other ways. The name TNT is an abbreviation of trinitrotoluene, which is the name given by chemists to the explosive in order to state its composition while designating it, and to thus distinguish it from many other nitrotoluenes known to them.

History

TNT has been known to chemists since 1863, and it was adopted as a military service explosive by 1902, but it did not become widely known until the Great War, when it came to be extensively used as bursting charges for high explosive shells, depth bombs, mines, torpedoes and other devices, and in demolitions where very violent detonation effects were sought to be produced with the largest measure of safety from these effects to the users. It was also used in admixture with other substances to produce other military explosives, such as amatol and sodatol.

Safety

Because of the devastating effects produced by the explosion of these devices charged with TNT, and because of the many most disastrous accidents which have occurred during the manufacture and transportation of large quantities of TNT under the hurried conditions necessitated by war conditions, many have been led to conclude that TNT is an especially dangerous explosive, but it really possesses characteristics which render it less dangerous than many explosives generally used in our industries. Thus it has been found more difficult to explode it with certainty than nitroglycerine, dynamite or gun cotton. In fact it was considered so safe that in 1910 the British government, on advice of its explosives experts, issued an order-in-council exempting it from being deemed an explosive, and subject therefore to the explosives regulations, during manufacture and storage unconditionally, and when conveyed and imported, provided it was perfectly packed. But this order has since been rescinded, and it may be proper to say in this connection that all substances possessing explosive properties should be treated with special care and surrounded by safeguards.

Industrial Use

With the cessation of hostilities this continent found itself with very large supplies of TNT on hand. So large, indeed, that it was deemed unwise to keep all of it in storage awaiting future military use, and it was proposed to devote many million pounds of it to industrial use. Now, although nitrotoluenes in admixture with other substances have been used as industrial explosives to a certain extent for more than a decade, TNT, as such, for several reasons, and especially because when its special value as a military explosive was recognized stocks of it were accumulated for war purposes, has not been used in industrial blasting except tentatively. It is not surprising, therefore, that objections should have been made to its suggested use as an industrial blasting agent, and doubts expressed as to its operativeness. It is the purpose of this paper to show how TNT may be safely and efficiently used in industrial blasting operations by those skilled in blasting and to correct many erroneous or misleading statements which have been circulated as to the properties of TNT by giving the results of careful experiments and observations, many of which have recently been made at the United States Bureau of Mines Experiment Station.

General Characteristics

When chemically pure TNT is a pale yellow, crystalline substance which acquires a deep yellow to brown color on exposure to light. It melts at about 80.5°C. (177.9°F.), and

when in the molten state it is cast into shells or run into cold water where it is granulated, by chilling, in the form of pebbles or pellets. TNT may, therefore, appear in granulated crystalline form, in pebbled or pelleted form, or in blocks or other cast forms. As offered by the Department of the Interior for use in blasting it is in the granulated crystalline form. Naturally, as produced on a large scale, TNT is not chemically pure, though the admixed substances are principally other nitrotoluenes which do not materially affect the explosive quality of the product though they do change its appearance and other physical characteristics. Thus the War Department secured and has alloted to the Department of the Interior for industrial use three grades of TNT as follows: Grade 1 having a setting point (S.P.) of 80°C. (176°F.); Grade 2, (S.P.) 79.5°C. (175.1°F.); and Grade 3, (S.P.) 76°C. (168.8°F.), the setting point of the molten TNT being employed by the Ordnance Corps, U.S.A., as the criterion of purity, because it is more readily observed with accuracy than the melting point of the solid. This Grade 1 appears as a dry granular crystalline powder, having a slight yellow color, and so fine that it will pass through a 30-mesh sieve. Because of its dryness it readily gives off dust; Grade 2 is a granular crystalline powder resembling light brown sugar, with a reddish tinge in color, and so fine that it will pass through a 12-mesh sieve. It is less dry and, therefore, less free-running and dusty than No. 1, and Grade 3 as a dry crystalline granular powder having a pale sulphur-yellow color, and so fine that it will pass through a 12-mesh sieve. It is not dusty, has the consistency of brown sugar, looks as if it were slightly moist, or greasy, and shows a tendency to cake, and is less free-running than No. 2.

Solubility and Hygroscopicity

TNT is almost insoluble in water. According to Marshall, water at 15°C. (59°F.) dissolves 0.021 per cent. of it, and at 100°C. (212°F.) 0.164 per cent. That is, 100,000 parts of water at 15°C. dissolve 21 parts of TNT, and at 100°C., 164 parts. The solubility of the different grades mentioned above is of the same order as this. In fact, the lower grades, and especially Grade 3, have a greasy feel and appearance and are, to a degree, water repellant. The proved solubility of TNT shows that it cannot be deliquescent ,or more than slightly, if at all, hygroscopic. Investigation at the Bureau of Mines Experiment Station has shown that it absorbs moisture when exposed to the atmosphere to about the same extent as powdered glass. This is for all practical purposes an entirely negligible quantity.

Packages

Military TNT, as offered for use in industrial operations, is packed in the granular crystalline form, in boxes made of white pine, ⅝-inches thick. The boxes are lock-cornered construction, and lined with paraffined paper. Most of the boxes of TNT received at the Explosive Experiment Station of the bureau were 22⅜ by 15¼ by 13 inches outside dimensions, and occupy a volume of 4,436 cubic inches (2.57 cubic feet). The boxes contained 100 pounds of TNT, and their gross weight averaged 113 pounds. It is possible that the boxes supplied by other manufacturers differ in dimensions and weight from these. The tops and bottoms are fastened on with nails. In opening the boxes, if force is necessary, the covers should be pryed off with wooden wedges. Grades 2 and 3 tend to cake during storage, and the lumps must be broken up to render the explosive "free running," so that it may be made into cartridges or loaded directly into bore holes. They may be so broken by pressing them with a wooden paddle or striking them light blows with a wooden mallet on a wooden surface.

Poisoning

TNT has a faint smell and a bitter taste. It produces brown stains on the skin which are difficult of removal. It is toxic and may produce poisoning by being inhaled as dust, or taken into the mouth, or by absorption through the skin but, unlike nitroglycerine, which produces severe headaches if but even a minute quantity touches the skin, rather long contact with TNT is required before its toxic effects become of moment. Nevertheless, those engaged in handling it, crushing the lumps and loading it into cartridges should avoid getting it into the nose and mouth, and clean their hands thoroughly before eating.

Detonation

TNT is more difficult to detonate with certainty than nitro-glycerine, dynamite, or the explosives ordinarily used in engineering operations, in mining and in quarrying. TNT charges require a No. 8 detonator (blasting cap) or electric detonator, while dynamite and the other high explosives ordinarily used in industrial operations require but a No. 6 detonator. Objection has been raised to the use of TNT on the ground of the increased cost consequent on the use of this stronger detonator. From inspection of current price lists it appears that No. 8 detonators cost nine-tenths of a cent more apiece than No. 6 detonators, and that No. 8 electric detonators cost 1.7 cents more apiece than No. 6 electric detonators.

Sensitiveness

As shown by tests with the pendulum friction device, all the three grades of TNT are less sensitive to friction than 40% straight dynamite, gelatin dynamite or picric acid, and as shown by tests with the large impact machine, all are sensitive to percussion than 40% straight dynamite, amonia dynamite and nitrostarch powders. It may be set on fire, when it will burn, but this burning may change to a detonation. Hence TNT must be protected from fire and causes of fire, such as sparks, flame, heated bodies, friction, percussion and the like, as all explosives should be at all times.

Gaseous Products of Detonation

In tests made at the Pittsburg Experiment Station by detonating TNT, Grade 1, and collecting the gases, it was found that 454 grams (one pound) of the explosive gave 506.5 liters of gases having the following compositions:—

Table I.—Gases from Detonation of Grade 1, TNT.

	Per cent. by volume.	Volume in liters.
Carbon dioxide	4.9	24.8
Oxygen	2.5	12.7
Carbon monoxide	46.6	236.0
Hydrogen	24.6	124.6
Methane	2.6	13.2
Nitrogen	18.8	95.2
	100.0	506.5

from which it appears that there was produced 46.6%, or 236 liters of a poisonous gas (CO), and 73.8%, or 373.8 liters of combustible gases (CO, H and CH_4). The tests of other grades of TNT gave similar, though not identical results, but all indicate it to be unsafe to use TNT in close places, such as underground workings and particularly coal mines. These results emphasize the importance of remaining away from the face of the blast after the explosion, until assured that the gases produced have been blown or have diffused away from the interstices of the debris. The safe waiting time will, of course, vary with the quantity of explosive fired, the location, such as a pocket, or valley, or plain, and the atmospheric conditions, particularly that of the force and direction of the wind. These precautions are such as should be taken with all explosives.

Relative Efficiency

In determining the relative efficiencies of explosives in use, the Bureau of Mines has long employed the "unit deflective charge," and the "rate of detonation" as criteria. The unit deflective charge is ascertained by exploding a known weight of the explosive in the ballistic pendulum and this term "unit deflective charge" is defined as "that weight of an explosive which will swing the ballistic pendulum the same distance as one-half pound of 40% straight nitro-

glycerin dynamite." It appears that the less the unit deflective charge, the greater the propulsive capacity of the explosive; hence, this is considered a measure of the ability of an explosive to dislodge and bring down material in which it is exploded.

Unit Deflective Charge

The unit deflective charge, in grams, of 40% dynamite and of Grades 1, 2 and 3 of TNT, with their corresponding percentage figures, using 40% dynamite as the basis of 100%, are given in the following tabulation:—

TABLE II.—UNIT DEFLECTIVE CHARGE OF FOUR EXPLOSIVES

	Dynamite	TNT		
Explosive.	40%.	1.	2.	3.
Unit deflective charge (grams) ..	227	201	199	209
Unit deflective charge (%)	100	113	114	109

From the above, it will be seen that each and every grade of TNT is stronger when so measured than 40% straight nitro-glycerin dynamite.

Rate of Detonation

The method of determining the rate of detonation is to charge the explosive in a file 1¼ inches in diameter and 42 inches long at normal density (that is, no unusual effort is made to get the explosive to a high density), and to fire the charge with a No. 8 electric detonator.

The "rate of detonation" is considered a measure of the ability of an explosive to disrupt and shatter material in which it is exploded.

The results of such tests are given in the following tabulation:—

TABLE III.—RATE OF DETONATION OF FOUR EXPLOSIVES

	Dynamite	TNT		
Explosive.	40%.	1.	2.	3.
Apparent specific gravity	1.24	0.91	0.88	0.86
Rate of detonation (meters per sec.)	4,772	4,747	4,852	4,482
Rate of detonation (%) .	100	99	102	94

Packing in Cartridges

It should be carefully noted that the comparisons made in the unit deflective charge table are by weight and in the rate of detonation table by volume. When either of the three grades of TNT are packed in cartridge cases, or in bore holes under ordinary tamping pressures, the apparent specific gravity of the charges vary from 0.81 to 0.95, while when 40% straight dynamite is so packed, the apparent specific gravity of its charges are from 1.15 to 1.34. It is evident, therefore, that for equal weights the TNT cartridges will be more bulky than the dynamite cartridges. As a consequence of this, larger bore holes must be used for TNT charges than for dynamite charges of equal weight. This presents an advantage for the dynamite over the TNT, but on the other hand, it has been observed that as the apparent specific gravity of the TNT approaches the lower limit given above, its resistance to wetting, when the cartridges are immersed in water, increases. Hence, it is recommended that except in assuredly dry holes, or in big blasts, where full boxes of the explosive may be fired in chambers, the TNT be packed for use in cartridges and that, as the No. 3 grade is the most water resistant of them all, it be packed at a low pressure and reserved for use in the especially wet work. To particularly distinguish the cartridges of grade 3, the wrappers may be of a specially chosen color or, better yet, they may be packed in paraffin coated wrappers and after the charge has been packed in these wrappers and the ends folded in, the ends should be redipped in the molten paraffin to completely seal them. For emergency use, newspaper may be employed for wrappers, being made up into cylinders of the desired dimensions by rolling about a pick handle or other convenient tool, but where considerable quantities are to be packed, it will be better to make a regular job of the operation, and to pack the explosive in the standard manilla wrappers, made by means of a cartridge machine.

It is only in large scale operations of crushing and repacking TNT into cartridges that there is much likelihood of any one becoming poisoned, for, as a rule, it requires continued contact with it through some period of time to produce this result. In handling TNT the following rules should be observed:—

Precautions in Packing

1. Only persons in good health should be employed.

2. Special clothing should be provided to be used only during working hours. Gauntleted gloves may be worn, but this is not necessary.

3. The hands and face should be washed before meals and before leaving the factory.

4. Care should be taken that none of the TNT comes in contact with the mucous membrane, such as that of the mouth, nose, eyes, etc. Workers should, therefore, be cautioned against touching these parts with their hands, or taking a chew of tobacco.

Cases of TNT poisoning which have occurred in considerable numbers in the factories operated under war conditions, appear to have resulted from neglecting to observe all the foregoing rules.

This poisoning is usually first evidenced by the appearance of a rash on the hands, neck or face. When this occurs, the case should receive prompt medical attention, and it would be desirable to transfer the person to other work. In this way, a worker who is easily susceptible to TNT poisoning will not be exposed to further danger. In factories where the opportunities for TNT poisoning are great, the effects are not usually evidenced until after five weeks of work.

Charging Bore Holes

TNT should be charged into bore holes, primed, tamped and stemmed in the manner customarily followed in the use of high explosives in blasting, special care being taken in charging wet holes not to tear or break the cartridge case or wrapper while loading it into the hole and tamping it. It may be used in chambering holes for subsequent charging with black blasting powder, just as dynamite is used. When TNT shots are fired, if the detonation is complete, there will be produced large volumes of dense, black smoke.

Practical Field Demonstrations

The practical value of TNT, grade 3, for general blasting purposes has been demonstrated by a number of field tests, such as adobe shots on boulders and concrete piers, blasting out oak stumps, splitting oak logs and shooting under water. In all the tests described herein the TNT was loaded in extemporized wrappers, made from newspapers, and detonated by a No. 8 electric detonator. A brief description of these tests, made at the Explosives Experiment Station by A. B. Coates, J. E. Tiffany and W. J. Montgomery, are as follows:—

Test No. 1—Adobe.—A 1½-pound charge of Grade 3 TNT was mudcapped with wet clay and fired on a sandstone boulder, 6 ft. long, 3 ft. wide and 1½ ft. thick. The largest piece obtained was 2 ft. by 2 ft. by 1 ft. Forty per cent. of the boulder was broken into fragments 2 ins. or less.

Test No. 2—Adobe.—In removing two concrete piers, 10 ft. long, 7 ft. high, 1½ ft. thick at top and 3½ ft. thick at bottom, an opportunity was given to compare TNT directly with 40% straight nitro-glycerin dynamite. All shots fired were adobe shots mudcapped with moistened clay. In six blasts, using a total weight of 10.7 pounds of TNT, 159.5 cubic feet of concrete were removed, or 14.9 cubic feet per pound of TNT, while in five blasts, using a total weight of 9.6 pounds of 40% straight nitro-glycerin dynamite, 135 cubic feet were removed, or 14.1 cubic feet per pound of 40% dynamite.

Test No. 3—Stump Blasting.—A solid oak stump 3 ft. in diameter, rooted in clay, was removed by the use of six 1½-pound charges of TNT, one charge being inserted under

(Concluded on page 174)

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ROAD TAX ON GASOLINE

RAISING money for roads has always been the hardest part of their construction. Various means have been suggested from time to time for financing roads more readily than by the present methods of taxation. Several months ago, C. A. Mullen, director of the paving department of the Milton Hersey Co., Ltd., Montreal, contributed an article to *The Canadian Engineer*, suggesting a wheel tax. Mr. Mullen now writes that his attention has been drawn to the possibility of raising funds by taxing the gasoline used by motor vehicles.

While this is not a new suggestion, having been discussed many years ago by Clifford Richardson, of the Barber Asphalt Paving Co., it is one which has not yet received the thorough consideration and discussion which it very evidently merits.

A tax on gasoline would in many ways be a very equitable method of raising funds for road construction. There is an analogy between the wheel tax and the gasoline tax, as both try to secure money from the actual users of the road in proportion to the service they receive. But the wheel tax does not take into consideration the extent to which the vehicle is used, while a tax on the gasoline is in direct relationship to the actual use. The more a vehicle is operated, naturally the more gasoline it requires; also, the heavier the vehicle, the greater the amount of gasoline it consumes per mile. Therefore a tax on gasoline would approximately be a tax per ton-mile.

As Mr. Mullen points out, there would be certain difficulties to be solved, such as finding a means for taxing vehicles not using gasoline, and devising simple ways of rebating the tax on gasoline used for purposes other than to generate power for transportation over highways. More discussion of this plan of taxation might lead to a solution of some difficulties.

CANADA'S FUEL PROBLEM

THERE is no necessity for Canada, with her vast resources of fuel and water-power, to go cold or to have her industries throttled by shortage of power, but Canada may have a sore trial in both these respects unless every possible effort is made to deal with the fuel and power situation in a comprehensive manner, writes Arthur V. White, consulting engineer of the Commission of Conservation, in the last issue of the "General Electric Review," published by the General Electric Co., of Schenectady, N.Y. Mr. White's article, "Canada's Fuel Problem—Some National and International Aspects," was reprinted in full in last week's issue of *The Canadian Engineer*, on account of the vital interest to Canada of his subject, and the broad and statesmanlike manner in which he deals with it.

The fuel problem of Canada must be solved by the engineers of Canada. It cannot be left entirely to politicians or financiers. Their help is needed, but the way must be and is being pointed out by Arthur V. White, R. A. Ross, C. A. Magrath, B. F. Haanel, James White, J. B. Challies, H. G. Acres, John Murphy, Arthur A. Cole, and a score of other prominent engineers who have specially studied the problem and who realize, better than any other group of men in Canada, the steps needed for its solution.

Mr. White's article was the twenty-eighth in a series on the more efficient utilization of America's fuel resources that is appearing, one article each month, in the interesting and well-edited "house-organ" of the General Electric Co. This series of articles forms a very important contribution to the existing literature upon the subject, and no doubt has been followed with interest by many of those engineers who have recognized the importance of the problems discussed.

Letter to the Editor

PRESENT SYSTEM IS CONVENIENT

Sir,—In connection with the present attempt to introduce the metric system into North America, attention is called to an apparently unobserved connection between length, volume and weight contained in our system.

The American railway usage of a 100 ft. chain, with the foot divided into tenths, hundredths and thousandths, is the only decimal system applicable to office, shop and field. The meter (almost 3.3 ft.) is too long for the office, and its next division, the decimeter (4 ins.), is too short for office use. A 20-meter chain (almost 66 ft.) is, like the Gunter chain, too short for railway work, and in levelling it is difficult to catch which meter is being read on the rod when close up.

The foot furnishes a remarkable relationship between volume and weight through the fact that a cubic foot contains 1,000 cubic tenths and a cubic foot of water weighs 1,000 ounces (62.5 lbs.). Thus a cubic tenth holds a fluid ounce of standard water, which weighs an ounce.

To apply this, imagine a box 1.5 tenths (0.15 ft.) by 1.5 tenths (0.15 ft.) by 2.7 tenths (0.27 ft.) long. It contains 6.075 cubic tenths (0.006075 cu. ft.) and will hold 6.075 fluid ounces of standard water, weighing 6.075 ounces av.

It would be possible to obtain a much better international measure by dividing a meter into three parts, calling each a metric foot (almost 1.1 ft.). This metric foot could be divided in tenths and the cubic tenth would weigh a metric ounce and hold a fluid metric ounce. One cubic metric foot, weighing 81.749 lbs. av., could be taken to contain ten metric gallons and to weigh 100 metric lbs. Each metric pound would contain 10 metric ounces. The "Canadian Magazine" published an article on this subject by the writer about 1895.

C. R. COUTLEE.

Ottawa, Ont., July 22nd, 1919.

PERSONALS

Major Alan Mair Jackson, who was recently appointed engineer of Brant County, Ont., was born in 1879, in New Zealand. He was educated at Dunedin High School and Otaga University, and served as an apprentice for six years in a foundry and machine shop, much of this time being spent in the erection of machinery. Major Jackson then became assistant engineer on drainage and sewerage in the city of Dunedin. Afterwards he served for six months as supernumerary engineer on a cargo tramp steamer, but left same upon its arrival at England. In 1905 he was sent to British Guiana to erect a gold dredge and to run a survey of a large gold dredging concession in the jungle. Subsequently he joined the Barima Gold Mining Co., in Demerara, on the border of Venezuela, where he erected all the company's machinery and built several miles of light railway. After four years in Demerara, Major Jackson returned to England in 1909, and early the following year came to Canada, where he spent a year in the mechanical department of the Canada Foundry Co., and then started a small engineering practice in Dunville, Ont. In 1912 he passed the O.L.S. examinations and became engineer for Haldimand County. The following year he moved to Brantford, Ont., and purchased the surveying and consulting practice of Howard Fairchild. In March, 1916, he enlisted as a captain in the 215th Battalion, but was soon promoted to the rank of major. He reverted to a captaincy upon his transfer to the 257th Railway Construction Battalion, with which unit he went to France. This battalion later became the 7th Battalion of Canadian Railway Troops. In France he was again promoted to the rank of major, and was in command of a company of the 7th Battalion for twenty-two months. In April, 1919, he returned to Brantford, and was appointed county engineer when construction work under the Ontario Highway Act was commenced by Brant County.

G. A. Kent, of Vancouver, gave an illustrated lecture recently before the Vancouver Board of Trade on a proposed extension of the Pacific Highway via Vancouver, Squamish and Lillooet, describing the scienic advantages of the route and the water power, timber and other natural resources that would be made available.

Sir Donald Mann, who is visiting British Columbia, has given an interview to the press in which he states that he is through with railroad construction. This is Sir Donald's first trip to the Pacific coast over the Grand Trunk Pacific Railway. He is very enthusiastic about the prospects of the interior of British Columbia.

Frank S. Easton, hydro-electric engineer with the British Columbia Electric Railway Co., Vancouver, has resigned to enter the employ of the Mexican Light & Power Co., with headquarters in Mexico City. Mr. Easton will have charge of certain hydraulic and electrical work for the company, under the direction of G. R. G. Conway, managing-director, who was formerly chief engineer of the British Columbia Electric Railway Co.

TNT AS A BLASTING EXPLOSIVE

(Continued from page 172)

each lateral root and one under the top root. The stump was broken into two about equal sized pieces which were thrown 35 and 65 ft. respectively from their original position. A crater 12 ft. in diameter and 4 ft. deep was formed. This shot was evidently overloaded.

Test No. 4—Stump Blasting.—An oak stump 3 ft. in diameter rooted in clay and sandstone fragments was removed by the use of eight ¾-pound charges, six being placed under the lateral roots and two under the centre. The stump was broken into four pieces, two large and two small. The large pieces were overturned at the edge of the crater, one small piece remained loose in the ground and the other was thrown about 75 ft.

In connection with this test, it is important to call attention to the fact that the charges were loaded in wet holes for a period of 1½ hours.

Test No. 5—Stump Blasting.—An oak stump 18 inches in diameter, rooted in clay was removed by a single 2-pound charge of grade 3 TNT placed under the centre of the stump. The stump was broken into two pieces and overturned at the edge of the crater.

Test No. 6—Stump Blasting.—A solid oak stump 3 ft. in diameter, rooted in clay was removed by four 1¾-pound charges placed under the lateral roots. The stump was split into three large pieces which were lifted about 10 ft. in the air and fell back into the crater.

Test No. 7—Log Splitting.—A solid oak log 6 ft. long, and 39 ins. diameter, was split into two separate pieces of practically the same size by 4 ounces of grade 3 TNT, loaded in a 2-inch hole located midway between the ends and about 2 inches beyond the centre of the log.

Test No. 8—Log Splitting.—A solid oak log, 6 ft. long, 44 ins. diameter at one end and 40 inches at the other, was split into two separate pieces of practically the same size by 5 ounces of grade 3 TNT, loaded as in Test 7.

Test No. 9—Wet Boreholes.—As the ability to use an explosive under water in very wet boreholes is of great importance, the following test was carried out: A borehole 1½ inches in diameter and 42 inches in depth was drilled vertically in the floor of a coal mine, through coal, limestone and fireclay. The top of the borehole was 4 ins. under water. As the maximum effect was sought, the borehole was overloaded with 2 pounds of grade 3 TNT, the explosive being pressed in sufficiently hard to break up the cartridges. No tamping was used. After a wait of 15 minutes, the charge was fired. A crater 4 ft. in diameter and 42 ins. deep was formed and considerable other material about the crater was so loosened as to be easily removed by a pick.

Conclusions

1. Grade 3 TNT can be successfully used for adobe shots of boulders, for removing stumps and for splitting logs.
2. Grade 3 TNT has shown itself to give results the equal of 40% straight nitro-glycerin dynamite.
3. Grade 3 TNT detonates completely with a No. 8 electric detonator.
4. The evidences of black smoke is not to be taken as an incomplete detonation.
5. Grade 3 TNT detonates completely under water.
6. Grade 3 TNT detonates completely after moderate immersion in wet holes.

ORDER YOUR BOOKS NOW

OWING to the great advance in the prices of paper, printing and binding, John Wiley & Sons, Inc., the well-known publishers, have found themselves compelled to increase the retail prices of a number of their publications, the advance to take effect August 20th. The prices of twenty-three of their leading books are being advanced by from 25c. to $1.00 per volume.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand or proposed, contracts awarded, changes in staffs, etc.

ADDITIONAL TENDERS PENDING

Not Including Those Reported in This Issue

Further information may be had from the issues of *The Canadian Engineer*, to which reference is made.

PLACE OF WORK	TENDERS CLOSE	ISSUE OF	PAGE
Burlington, Ont., sewers	July 25.	July 17.	48
Fort Qu'Appelle, Sask., boilers, etc.	July 31.	July 10.	48
Grosse Isle, Que., wharf	Aug. 5.	July 17.	52
North Arm., B.C., dredging	July 30.	July 10.	52
Port Essington, B.C., float and approach	July 31.	July 10.	52
Regina, Sask., pavement	July 30.	July 17.	46
St. Gregor, Sask., telephones	July 25.	July 17.	52
Toronto, Ont., pipes and valves.	July 28.	July 17.	45
Toronto, Ont., highway	July 30.	July 17.	46
Toronto, Ont., electrical building	July 28.	July 17.	50
Weyburn, Sask., heating, etc.	July 26.	July 10.	48
Winnipeg, Man., garage	July 28.	July 17.	52
York County, Ont., bridge	July 28.	July 17.	45
York Township, Ont., water mains	Aug. 5.	July 17.	45

BRIDGES, ROADS AND STREETS

Amherstburg, Ont.—Sealed tenders will be received until 8 p.m., July 28th, for the construction of Silex stone walks on the following streets: St. Arnaud; Laird; Alma and William. W. A. McCormick, town clerk.

Burlington, Ont.—The work on the Burlington end of the Beach road is progressing rapidly, one-half of the road to be completed before work on the other half is commenced. A permanent base is being laid.

Bury, Que.—Contract for reinforced concrete bridge has been awarded to S. J. Davies, Bury. Tender price, $1,448.

Bury, Que.—Following tenders for 7½ miles Beauceville-Sherbrooke Road were received by the Department of Roads, Quebec: Howick Paving Co., New York, $77,803.68; J. H. Worby, Bury, Que., $60,994.12; R. E. & J. L. Willard, E. Angus, Que., $65,000; Loomis Dakin Construction Co., Sherbrooke, Que., $57,008.73. Edgar Irvine and Deoits Bros., Montreal, $56,758. No contract has as yet been awarded.

Charlesbourg, Ont.—Tenders will soon be called for construction of concrete highway on St. Joseph's road. M. Henry, engineer, department of roads, Quebec.

Edmonton, Alta.—New plans for extensive road work in different parts of the province will be made by the government when the federal grant for highway improvement comes through. Alberta, in common with the other provinces, is due for a first instalment of $80,000.

Edmundston, N.B.—The Dominion Government has made an appropriation of $25,000 for erection of bridge over St. John River.

Gladstone, Man.—Contract for two pile bridges over White Mud River, in the municipality of Westbourne, has been awarded to A. Power, 249 River Ave., Fort Rouge, Winnipeg, Man. Tender price, $4,322.55.

Gloucester, Ont.—The township council is receiving tenders for 7,245 lineal feet of granolithic sidewalks.

Halifax, N.S.—Canadian National Railways, Moncton, N.B., have awarded contract for the construction of the Tantramar River bridge to the Nova Scotia Construction Co., Ltd., Halifax.

Halifax, N.S.—Contract for Bedford Road has been awarded by the highway board to the Barrett Co. Tender prices, earth excavation, $1.50 per cu. yd.; rock excavation, $3.00 per cu. yd.; paving, $1.60 per sq. yd.

Halifax, N.S.—The city department of works has awarded contracts for street paving totalling $800,000.

Hope, B.C.—A trans-provincial highway is proposed between Hope and Princeton. Construction of about 100 miles of road is involved.

Kenogami, Que.—Tenders will soon be called by the municipal council for pavements costing about $15,000. Chas. Lightwood, clerk.

Kingston, Ont.—Contract awarded by the department of public works, Dominion government, to John F. Sowards, Kingston, for placing stone rip-rap along Lasalle Highway.

Kingston, Ont.—Tenders for asphalt concrete roads were considered too high by the board of works. Three tenders were received, ranging from $4 to $4.05 per sq. yd. As the city engineering department is doing the same paving at the present time for $2.10 a sq. yd., the board decided that this work should be done by day labor.

TOWNSHIP OF YORK

CONSTRUCTION OF WATER MAINS

Sealed tenders, plainly marked as to the contents, will be received by the undersigned engineer for the Municipal Corporation of the Township of York up to 10 o'clock a.m., Tuesday, August 5th, 1919, for the construction of 6-inch cast-iron water mains in the following streets in the Township of York:—

1. Atlas Ave. North (1,124 ft.).
2. Hanson Road, Rockvale Ave., Clovelly Ave., Strader Ave. (2,840 ft.).
3. Miller Ave., Northcliffe Blvd., Westmount Ave. (1,940 ft.).
4. Robina Ave., Cedric Ave., Holland Park Ave., Wilmington Ave. (4,460 ft.).
5. Tay Ave., Glanville Ave., Rushton Road, Durham Ave. (3,370 ft.).
6. Bernice Ave., Eileen Ave., Mildred Ave., Lyndon Ave., Elvin Ave., Scarlett Road (7,190 ft.).
7. Florence Cres., White Ave., Brooke Ave., Pritchard Ave., Jane St. (4,200 ft.).
8. Thornhill Ave., Priscilla Ave., Windermere Ave., Brookside Ave., Bradley Ave. (7,530 ft.).

Plans and specifications and all necessary information may be obtained at the office of the Engineer, Frank Barber, 40 Jarvis Street, Toronto.

The lowest or any tender will not necessarily be accepted.

FRANK BARBER,
Engineer.

Toronto, July 14th, 1919. 298

Kipling, Sask.—Tenders will be received until noon, July 28th, by H. A. Dixon, chief engineer, Can. Nat. Rys., Winnipeg, Man., for the construction of three reinforced concrete culverts, Mile 142 to Mile 173, Kipling Subdivision. Plans, specifications, instructions to bidders and form of tender can be obtained at the offices of the chief engineer, Winnipeg; superintendent, Brandon; district engineer, Saskatoon, and freight agent, Regina.

Kitchener, Ont.—The county council has awarded contract for three miles of road to Lichty Bros., Wellesley. Tender price for sections, St. Jacobs, $1,942.40; Wellesley, $3,780; Woolwich, $42,659.20. The St. Jacob's section will be 14 feet wide, an area of 12,600 square feet. The Wellesley section will be 20 feet wide and area of 21,000 square feet, and the Woolwich section will be 16 feet wide and area of 28,160 square yards.

Lancaster, Ont.—Town council will soon call for tenders for construction of sidewalks. Estimated cost, $10,000.

Lanigan, Sask.—The C.P.R. Co. has awarded contract for two bridges to C. Anderson and A. J. Creelman.

L'Assomption, Que.—The following tenders have been received for bridge between Repentigny and Charlemagne by the county council. The award will not be made before August 11th: Superstructure, Phœnix Bridge and Iron Works, Ltd., $41,295; Mackinnon Steel Co., Ltd., $33,950. Substructure, Nicolet Construction Co., Ltd., $34,689; J. A. Brouillet, L'Assomption, $31,530.

Markham, Ont.—Tenders will be received until noon, August 2nd, by G. A. Davidson, township clerk, for three concrete bridges. Plans and specifications may be seen at the clerk's office or at the office of the engineers, James, Loudon and Hertzberg, Ltd., 36 Toronto St., Toronto.

Montreal, Que.—Tenders will be received by the Administrative Commission, city hall, until noon, July 28th, for the demolition of the old, and the construction of a new wooden bridge over the aqueduct at Woodland Ave. Rene Bauset, city clerk.

Montreal, Que.—Tenders will be received until noon, July 29th, by the Administrative Commission, city hall, for construction of a block and asphaltic composition pavement on Redpath St., from Sherbrooke St. to the north limits. Rene Bauset, city clerk.

Nanaimo, B.C.—It is proposed to extend the Island highway, twenty-two miles from Campbell River, to open up the Sayward Valley for settlement. Mr. Stewart, M.P.P., for Comox district.

Newmarket, Ont.—The town council has awarded the contract for reconstruction of the Prospect Street bridge, recently washed out, to the Lewis Construction Co., Toronto.

Ormstown, Que.—The municipal council will soon call for tenders for about 9 miles of road work.

Repentigny, Que.—Tenders will soon be called by the municipal council for construction of bridge.

St. Antoine, Que.—Tenders are being received by the municipal council for waterbound macadam highway.

St. David, Que.—The municipal council has awarded contract for bridge to The Nicolet Construction Co., Nicolet, Que.

St. Placide, Que.—Tenders will soon be called by the village council for road work.

Victoria, B.C.—Plans have been approved for steel bridge of Bascule type by the provincial government and C.P.R. Co.

Winnipeg, Man.—Plans have been prepared for Maryland bridge. It will consist of three spans of 150 feet each, with double street car tracks.

WATER, SEWAGE AND REFUSE

Amherstburg, Ont.—Walter Mann has been awarded contract for sewer at $1,098.97.

Brandon, Man.—Contract for two motor-driven centrifugal pumps for Hospital for Insane has been let by the Provincial government to The Goldie & McCulloch Co., Ltd., Galt, Ont., for $2,940.

Cochrane, Ont.—Extension to waterworks system is contemplated by the town council. Clerk, H. J. Brown.

Drumbo, Ont.—Tenders will be received by Hugh Allan, township clerk, Drumbo, until noon, July 26th, for the construction of the lower portion of the Bremner Creek drain, in the 4th concession of the township of Blenheim. Plans and specifications may be seen at the clerk's office, Drumbo.

Kingston, Ont.—The department of public works, Ottawa, has awarded contract for sewerage system and disposal works, Sydenham Convalescent Hospital, to W. H. Harvey, Kingston. Contract price, $10,403.50.

Kitchener, Ont.—The water supply of the city of Kitchener has decreased in volume lately owing to a shortage in pumping capacity. It is understood that the Water Commission will instal a new compressor shortly to augment the supply derived from wells.

Lethbridge, Alta.—The city council plans installation of meters for water. Estimated cost, $35,000.

Montreal, Que.—Contract for the construction of a sewer in Plamondon St. and Decarie Blvd. was awarded to A. T. A. Chagnon & Co. for $7,171.

Montreal, Que.—Tenders for sewers on Plamondon St. and Decarie Blvd. were received from the following firms at prices mentioned: DeKeyser Wauters Cie, $8,360; Filion and Frères, Ltée, $7,892; Chas. G. Craib, $8,332; J. Ricci and J. Désautels, $9,220.50; Léopold Toussaint, $12,372.50; The Federal Engineering and Constructing Co., Ltd., $8,835; D. Vocisano, $7,343; John Quinlan and Co., $12,439; Atlas Construction Co., Ltd., $9,906; Joseph Rondou, $8,184.75; A. T. A. Chagnon and Cie, $7,171; O. Filion, $9,130; E. T. Verbanise, $8,567; city of Montreal, $9,987.

Newmarket, Ont.—Sealed tenders will be received until noon, August 7th, for the construction of storm and sanitary sewers. (Official advertisement in this issue.) Town clerk, P. J. Anderson. Engineers, James, Loudon & Hertzberg, Ltd., Toronto.

Newmarket, Ont.—Tenders, sealed and marked, will be received by P J. Anderson, town clerk, up to noon, August 7th, for the construction of storm and sanitary sewers. Plans and specifications may be seen at the office of the engineers, James, Loudon & Hertzberg, Ltd., 36 Toronto St., Toronto, or at the office of the clerk, Newmarket.

North Bay, Ont.—Sealed tenders will be received until 12 o'clock noon, August 2nd, for the construction of sewers on the followning streets: Cassels St., from Worthington to First Ave.; McIntyre St., from a point west of Bell St., 170 ft.; Bloem St., from Klock Ave., 250 ft. westerly; Worthington St., from Sherbrooke to Wyld St. H. J. McAuslan, town engineer.

Ottawa, Ont.—The city council will soon call for tenders for drainage system for Holland Ave district. Estimated cost, $38,000.

Peterborough, Ont.—Erection of a filtration plant is contemplated by the city council. Estimated cost, $200,000. W. H. Moore, Utilities Commission.

Point Grey, B.C.—Plans are being prepared for sewerage system for the Vancouver and District Sewerage and Drainage Board.

Saanich, B.C.—The municipal council, Royal Oak, contemplates construction of sewerage system to include Cloverdale and Gorge districts.

Sandwich, Ont.—Tenders have been awarded by the town council for sewers and paving for a total cost of $85,000. Sewers will be constructed on Huron Line, Brock St. and Josie Ave., and paving will be laid on Centre Rd. The sewers will cost $70,000, while the paving will cost $15,000.

Vermilion, Alta.—The town council contemplates construction of fire tanks of 30,000 gallons capacity.

Barrett Specification Roof on Plant of Tabor Ice Cream Co. Architect: C. D. Cooley Co. Roofer: Lee H. Gould & Co. Gen. Contrs.: The Reaugh Con. Co.
Barrett Specification Roofs

The roof on this plant is soaking wet 24 hours a day, 365 days in the year!

Can you imagine a more severe test than to have a *perpetual shower falling on a roof every day and night year in and year out?*

This is what happens to the Barrett Specification Roof on the Tabor Ice Cream Co. plant illustrated above.

This shower comes from the big water-cooler on top of the structure which is used for cooling the ammonia.

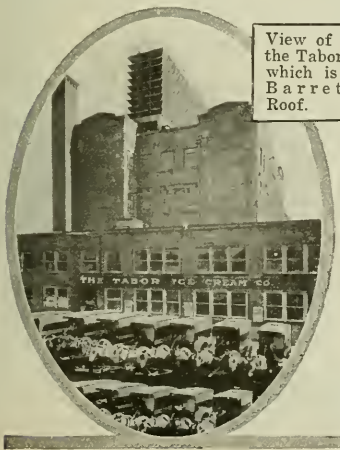
No ordinary roof would stand up under such conditions.

And that is why the Tabor Ice Cream Co. had its million-dollar plant protected with a Barrett Specification Roof.

Even such a severe test has no terrors for a Barrett Specification Roof because it is planned to meet just such extreme conditions.

No other roof contains as much protective waterproofing material in its construction, and that is the reason these roofs give such long and satisfactory service.

Not only do Barrett Specification Roofs last longer than others, but they *cost less per year of service;* they take the base rate of insurance and *carry a 20-Year Surety Bond Guaranty.*



View of the building of the Tabor Ice Cream Co., which is roofed with a Barrett Specification Roof.

20-Year Guaranty

We now guarantee Barrett Specification Roofs to last for twenty years without cost for maintenance. No charge for the guaranty, for it gives us a chance to protect the good repute of these roofs. The guaranty is a Surety Bond issued by one of the largest surety companies in the world. It is offered on all roofs of fifty squares and over in all cities of 25,000 population and more, *and in smaller places also where our Inspection Service is available.*

A copy of the Barrett 20-Year Specification, with roofing diagrams, sent free on request.

The Barrett Company LIMITED

MONTREAL TORONTO WINNIPEG VANCOUVER
ST. JOHN, N.B. HALIFAX, N.S. SYDNEY, N.S.

Waterford, Ont.—The town council has decided to instal waterworks system. W. S. Fuller, clerk.

Windsor, Ont.—Plans have been prepared for $100,000 pumping station and filtration plant for seven border municipalities.

York Township, Ont.—Contracts have been awarded for laying of 6-in. water mains on Burton St., to McKnight Construction Co., Toronto, $4,064.54. Rejected tenders, Murphy Construction Co., $4,633.17; Angelo Cavoti, $5,390.29; on Graham Ave., to Angelo Cavoti, $2,302.78. Rejected tenders, Murphy Construction Co., $2,575.85; McKnight Construction Co., $2,648.85. Frank Barber and R. O. Wynne Roberts, engineers.

LIGHT, HEAT AND POWER

Amherst, N.S.—The Canada Electric Co., Ltd., will increase power capacity.

Barnet, B.C.—The British Columbia Electric Ry. Co., Vancouver, has had plans prepared for transformer station.

Camrose, Alta.—By-law has been passed authorizing expenditure by the town council for power plant.

Galetta, Ont.—The Galetta Power and Milling Co. contemplates construction of extensions to transmission line.

Naramata, B.C.—Contract for power house has been awarded by the town council to J. Winger, Peachland, B.C.

Ottawa, Ont.—Contract for electric fixures and lamps in the Hunter Building has been awarded by the department of public works, Dominion government, to A. A. Giddings & Co., Montreal.

Portage la Prairie, Man.—Contracts have been let by the department of works, Winnipeg, for the construction of the Portage Power Transmission lines as follows: Galvanized steel towers, Canadian Bridge Co., Walkerville, Ont., $96,160; construction work, W. J. Holmes, $46,000; aluminum steel conductor, Northern Aluminum Co., Toronto, $34,123; insulators, Canadian Porcelain Co., Hamilton, Ont., $30,000; galvanized steel cable guy wires, Northern Electric Co., Winnipeg, Man., $9,000; transformers, Canadian General Electric Co., Winnipeg, $22,600. Hon. George Grierson, Winnipeg.

Regina, Sask.—Tenders for the supply of power and light extension material has been awarded by the commissioners as follows: Moloney Electric Co., Toronto, $5,722; Parkard Electric Co., Winnipeg, $4,675; Canadian General Electric, $3,112; Lyman Tube & Supply Co., Winnipeg, $378.40; Northern Electric Co., $306; Dawson & Co., Montreal, $271.60; Northern Electric Co., $228.

Saskatoon, Sask.—Sealed tenders, endorsed "Turbo Generator," will be received by C. J. Yorath, city commissioner, up to noon on Tuesday, September 23rd, 1919, for the following: First contract—One steam turbine, one alternating current generator and switchgear equipment. Second contract—One surface condenser and condenser auxiliaries. Forms of tender, etc., may be obtained upon application to the city commissioner.

Saskville, N.B.—The Eastern Electric and Development Co., Ltd., contemplates further development.

St. Raphael, Que.—Gauvin & Lessard, engineers, 147 Cote de la Montagne, Quebec, have completed plans and specifications for a water power development here (Bellechasse County), and are in the market for two water wheels of 1,100 h.p. each; head, 245 ft. Also two generators; exciters; switchboards; one penstock, 8,020 ft. long; one head gate; and construction of transmission line, 16 miles, 3-phase, 55,000 volts. La Corporation Electrique de Montmagny, owner.

St. Stephen, N.B.—L. H. Whealen, Halifax, has prepared plans for additions to plant for the St. Stephen Electric Light Co.

Sutherland, Sask.—Sealed tenders will be received until 12 o'clock noon, Tuesday, August 5th, by the department of public works, Ottawa, for an automatic lighting plant, wiring, fixtures and pole line, Forest Nursery station. Plans and specifications may be obtained from the chief architect, Ottawa; clerk of works, Regina, and caretaker, public building, Saskatoon, Sask. R. C. Desrochers, secretary.

Vancouver, B.C.—The Western Power Co. of Canada, Vancouver, contemplates extensive water power development.

Vernon, B.C.—The municipalities between Kamloops, B.C., and Kelowna, B.C., will petition the government to develop sufficient electrical energy from the Adams River and Shuswap Falls to supply power to the Shuswap and Okanagan valleys, and to electrify the Okanagan branch of the Canadian Pacific Railway.

Wiarton, Ont.—The Sauble Falls Light Co., Wiarton, Ont., plans development of power.

RAILWAYS

Fredericton, N.B.—The St. John Valley Railway will be completed by the contractors so as to be handed over to the Dominion government for operation as part of the Canadian National Railways before August 1st. Hon. W. P. Jones, president of the St. John and Quebec Railway Co. and representative of the New Brunswick government in the construction.

Guelph, Ont.—Extension of the Toronto Suburban Railway from Guelph to Kitchener, Stratford and London, and perhaps on to Windsor or Sarnia, as one of the links of the new Canadian National Railways system is planned by the Dominion government.

Halifax, N.S.—The Nova Scotia Tramways Co. will undertake extensive track renewals; construction of additional cars; extension of lines, and will increase the present equipment of their power stations. Estimated cost, $1,000,000.

Montreal, Que.—The electrification of the railway of the Montreal Harbor Commission will likely be commenced this month, to be completed late in the fall.

Owen Sound, Ont.—W. F. Tye, Montreal, has been instructed to prepare plans on the interswitching problem.

Sarnia, Ont.—The city council contemplates street railway extensions.

Toronto, Ont.—Plans will be prepared and tenders will soon be called by the Ontario Railway Board for construction of a temporary electric railway on Mount Pleasant Rd. Estimated cost, $1,142,294.

Victoria, B.C.—Eighteen miles of grading on the Pacific Great Eastern Railway is now complete, and arrangements are being made to commence track-laying towards Williams Lake at the rate of one and a half miles per day. Ballasting and surfacing operations are proceeding satisfactorily, and the foundation work for Deep Creek bridge is under way.

Weston, Ont.—Several switches will be constructed on the radial line between Toronto and Weston by the Canadian National Railways.

Winnipeg, Man.—The Canadian Pacific Railway Co. have awarded contracts covering construction of more than 200 miles of line. The John Stewart Construction Co., Vancouver, will construct the lines from Mildend, to Empress, 34 miles; from Consul to Assiniboia, 30 miles; from Lanigan to Carrot River, 50 miles, and from Rymark to Archive, 50 miles—all in Saskatchewan. The Canadian Construction Co., Winnipeg, will construct from Rosetown, Sask., south, 25 miles. The Northern Construction Co. will construct from Russell, Sask., 12 miles north. D. C. Coleman, vice-president.

FACTORIES AND LARGE BUILDINGS

Arnprior, Ont.—The Arnprior Cabinet Co., Ltd., will erect large addition to factory. R. J. Simpson, vice-president and general manager.

Belleville, Ont.—New fire hall will be erected at entrance to Victoria Park.

Beynon, Alta.—Tenders will be received until noon, August 1st by the board of trustees, school district No. 3811, for

Burlington Steel Co., Ltd.
Hamilton, Canada

STEEL BARS
For
Concrete Reinforcing

THE MOST IMPORTANT FACTOR IN CONCRETE REINFORCEMENT IS THE TENSILE STRENGTH AND ELASTIC LIMIT OF THE REINFORCING BAR.

OTHER THINGS BEING EQUAL, STEEL HAVING THE HIGHEST ELASTIC LIMIT, OR YIELD POINT, WILL BE THE MOST SATISFACTORY FOR REINFORCEMENT. WHEN UNDER STRAIN, AS SOON AS THE ELASTIC LIMIT OF ANY REINFORCING BAR IS REACHED, THE METAL STRETCHES RAPIDLY DECREASING IN SECTION, DRAWING LOOSE FROM THE CONCRETE AND DESTROYING THE MONOLITHIC BOND EXISTING BEFORE THIS POINT IS REACHED THEREFORE, THE SAFETY OF THE ENTIRE CONSTRUCTION IS IN DIRECT PROPORTION TO THE ELASTIC LIMIT OF THE STEEL USED.

THE ELASTIC LIMIT OF RAIL CARBON STEEL IS 50,000 TO 60,000 POUNDS PER SQUARE INCH, EITHER TWISTED OR PLAIN, AS COMPARED WITH AN ELASTIC LIMIT OF 25,000 TO 30,000 POUNDS IN SOFT STEEL.

THAT'S WHY RAIL CARBON STEEL, WITH ITS 80,000 POUNDS MINIMUM TENSILE STRENGTH, IS RECOMMENDED AS BEING FAR SUPERIOR FOR ALL KINDS OF REINFORCED CONCRETE WORK.

AT OUR HAMILTON, ONT., WORKS WE BUY SELECT RAILS, AND ROLL THEM INTO RAIL CARBON STEEL REINFORCING BARS IN A PLANT WHICH IS THE EMBODIMENT OF THE LATEST THOUGHT AND PRACTICE.

THESE BARS CAN BE SUPPLIED FROM STOCK IN VARIOUS SIZES, LENGTHS AND SHAPES. WE CAN ALSO ROLL SPECIAL SHAPES AND SIZES TO FIT YOUR PARTICULAR REQUIREMENTS.

Bars bent to shape for Beams, Stirrups, Etc.

PROMPT SHIPMENT

the erection of a new frame building. F. J. Kelly, secretary-treasurer.

Brandon, Man.—Tenders will be received until 12 o'clock noon, July 29th, by the commissioner of the R.N.W.M.P., Regina, Sask., for the construction of new barracks. Architect, H. E. Matthews, 802 Lindsay Building, Winnipeg, Man. A. B. Perry, commissioner, Regina.

Burnaby, B.C.—The Alexander Cunningham & Gregory Tire & Rubber Co., care Imperial Oil, Vancouver, contemplates erection of rubber plant, and have applied to the Burnaby council for certain concessions.

Calgary, Alta.—According to A. W. Dingman, managing director of the Calgary Petroleum Products Co., the enlarged gasoline extraction plant which is now being installed by the Hope Engineering & Construction Co. at the No. 1 and No. 2 wells of the oil concern in the Black Diamond field, will start operating soon. The new plant's rated capacity is the treatment of 6,000,000 cubic feet of wet gas per 24 hours.

Camrose, Alta.—The Continental Oil Co. plans to build warehouse.

Canford Mills, B.C.—Lumber mills, sawmills, planing mills, etc., recently destroyed by fire, will be re-erected by the Canford Mills Co.

Chicoutimi, Que.—Sealed tenders will be received until 12 o'clock noon, August 9th, by the Canadian National Railways, for the erection of a station building. Plans, etc., may be obtained from the district engineer, Champlain Market, Quebec, Que., and Tunnel Terminal Station Building, Montreal, Que. A. F. Stewart, chief engineer, Toronto.

Collingwood, Ont.—The Gregory Tire & Rubber Co. will erect factory here.

Davidson, Sask.—The Davidson Co-operative Association contemplates addition to warehouse.

Duck Lake, Sask.—The erection of a grain elevator is planned by the North Star Elevator Co.

Dundas, Ont.—W. H. Yates, Hamilton, Ont., has been awarded contract for addition to public school. Tender price, $60,516. Work has commenced and contract calls for its completion by October 15th.

Essex, Ont.—Tenders will be received by E. L. Park, chairman building committee, Essex, Ont., until noon, July 28th, for alterations and additions to the I.O.O.F. building. Plans and specifications can be seen at the office of J. C. Pennington, architect, 35 LaBelle Building, Windsor, or at William Chatterton's store, Essex.

Fort Qu'Appelle, Sask.—Plans have been prepared for skating rink to be erected by town council.

Glace Bay, N.S.—Tenders will be received until August 1st for the laying of a new floor and other repairs to the Alexandra Rink. James A. Campbell.

Grosse Isle, Que.—The department of public works, Ottawa, has awarded contract for construction of operating house, Radiotelegraph station, to Delphe Maranda, Que. Contract price, $2,340.

Halifax, N.S.—Contract for train shed, Halifax Ocean Terminals, has been awarded to James Shearer Co., Ltd., Montreal.

Halifax, N.S.—The Nova Scotia Tramway & Power Co., Ltd., contemplates extensions to plant.

Hamilton, Ont.—The department of public works, Ottawa, has awarded contract for construction of Postal Station "B" to Kennedy Connor, Hamilton. Contract price, $36,650.

Hanover, Ont.—The Portland Cement Co. contemplates remodelling plant.

Harrow, Ont.—The John V. Grey Construction Co., Toronto, have been awarded contract for warehouse by W. Clarke, Ltd., 83 Amherst St., Montreal.

Hull, Que.—The department of agriculture, Ottawa, has awarded contract for construction of cattle barn at the Research Station, Health of Animals branch, Hull, Que., to Doran & Devlin, Ottawa. Contract price, $5,380.

Kingston, Ont.—The city council has decided that tenders submitted for new school were too high. A resolution has been passed recommending to the board of education that new tenders be called about November 15th, and that stone as well as brick be specified. The school is to consist of ten rooms. Estimated cost, $135,000.

Kingston, Ont.—The department of public works has awarded contract for nurses' home at Mowat Sanatorium to McKelvey & Berch, Ltd., Kingston.

Kitchener, Ont.—The F. W. D. Auto Co. will commence construction of their new factory in the east end of the city as soon as they received definite information on the new location of the Grand River Railway. J. Cotton, Clintonville.

Ladner, B.C.—The Bank of Montreal is erecting a building in this town.

Montreal, Que.—Tenders will be received until noon, August 4th, by the Marcil Trust Co., for the construction of an office building on St. James St., opposite Victoria Sq. Architect, Hogle and Davis, 80 St. Francois Xavier St., Montreal.

Oakville, Ont.—Town council has approved the expenditure by the board of education of $22,000 for new school building.

Petrolea, Ont.—Tenders will be received until August 7th, by the board of governors of the Charlotte Eleanor Englehart hospital for the construction of a nurses' home. Architect, Isaac Erb, Port Huron. Wm. Pratt, secretary, Masonic Temple, Petrolea, Ont.

Picton, Ont.—A new factory will be built by Kinney and Colliver on Barker St.

Portage la Prairie, Man.—Tenders will soon be called for enlarging public building. Estimated cost, $25,000.

Port Arthur, Ont.—The Barnett & McQueen Co. here have been awarded contract by the department of public works for new workhouse at the Canadian National elevator. The elevator workhouse will have a capacity of 700,000 bushels, and will be constructed of reinforced concrete. An electric sub-station will be erected to operate the plant.

Red Mill, Que.—The Canada Paint Co., 572 William St., Montreal, will erect factory here.

Regina, Sask.—The Capital Broom Manufacturing Co. will erect three new buildings on lots Nos. 11 and 12, block No. 23, eastern annex. Estimated cost, approximately $7,500.

Regina, Sask.—Thos. Barnard has been awarded contract for new Duncan block, corner of Dewdney and Albert Streets. Tender price, about $30,000.

Rosser, Man.—Debentures will be issued to the amount of $18,000 for erection of school. W. H. Beachell, secretary-treasurer, Rosser, Man.

South Vancouver, B.C.—The Gregory Tire and Rubber Co. will erect their new factory on Euclid Ave. and Joyce Rd.

St. Boniface, Man.—Contract for materials for parish church has been given to the Canadian Investment Co. Moen Bros. have the contract for structural work.

St. Catharines, Ont.—Tenders will soon be called for extension to public building.

St. John, N.B.—Time for receiving tenders for the construction of a nurses' residence at the general public hospital has been extended to July 31st. Tenders to be addressed to Henry Hedden, M.D., secretary of the board of commisisoners. Plans and specifications may be seen at the office of the architect, F. Neil Brodie, 42 Princess St.

St. Thomas, Ont.—Site has been secured at Penafore Park for pavilion. Architect Darrach is preparing plans. Estimated cost, $8,000.

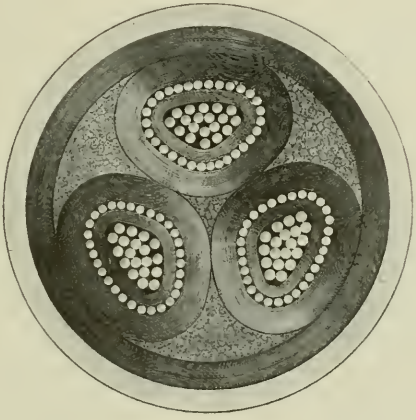
Sydney, N.S.—Contract for the construction of a coaling plant and sand-house has been let by the Canadian National Railways, Moncton, N.B., to Williams & Wilson, Ltd., Montreal.

Three Rivers, Que.—Telesphore Dugre, Three Rivers, has been awarded contract for theatre. Tender price, approximately $25,000.

Three Rivers, Que.—The Three Rivers Shipbuilding Co. plan erection of additional buildings soon.

Three Rivers, Que.—The Tidewater Shipbuilding Co. contemplates extensions at an approximate cost of $250,000.

SPLIT-CONDUCTOR CABLES



250,000 C.M. 3-CONDUCTOR 13,200 VOLT
PAPER-INSULATED, LEAD COVERED CABLE

Eugene F. Phillips Electrical Works, Ltd.

MONTREAL

Branches: Toronto, Winnipeg, Regina, Calgary, Vancouver

Toronto, Ont.—Separate tenders will be received until noon, August 1st, by A. F. Stewart, chief engineer, eastern lines, Canadian National Railways, 27 Wellington St. East, Toronto, for three section houses, two stations, five coal and oil houses, and 21 bunk houses. Plans and specifications may be seen at the office of Geo. C. Briggs, architect, 27 Wellington St. East, Toronto, and D. Couper's office, G.N.W. Telegraph Building, corner Sparks and Metcalfe St., Ottawa.

Toronto, Ont.—The following building permits have been granted by the city architect's department: C. G. Webby, brick apartment addition, 216 Avenue Rd., $8,000; W. Robertson, one pair semi-detached two-story brick dwellings, 49-51 Blackthorne Ave., $4,500; J. Taylor, two-story brick addition, 24 Ellerbeck Ave., $3,000; Wm. Watson, two-story brick dwelling, 113 Mackay Ave., $3,000; G. W. Edgar, to alter dwelling to duplex, 372 Annette St., $2,000; R. M. Sheppard, three two-story brick and frame dwellings, 111, 121, 139 Runnymede Rd., $10,800; Cox & Cummings, two-story brick and stucco dwelling, near McLean Ave., $4,500; Fred J. Cummings, 4 two-story brick and concrete stores, 2304-10 Queen St. E., $12,000; James Wilkins, one detached two-story brick, tile and stucco dwelling into private garage, 40 Oakmount, $8,000; Wm. Davies, one-story addition to brick house, 521 Front East, $6,000.

Toronto, Ont.—The new public library to serve the increasing demands of the Earlscourt district will soon be under construction. The new site will be on Dufferin St., south of St. Clair Ave.

Toronto, Ont.—Tenders will be received until noon, July 29th, by the York Township Housing Commission, 40 Jarvis St., for construction of brick houses in Oakwood, West Toronto, Mount Dennis, Forest Hill, Armour Heights, Swansea and Earlscourt districts.

Toronto, Ont.—$6,500 will be expended by the Imperial Extract Co., Don Improvement Roadway, on addition to factory.

Toronto, Ont.—Tenders will be received until July 28th, by board of education, W. C. Wilkinson, secretary-treasurer, for teachers' revolving chairs, pupils' desks and seats, heating and ventilating, new boilers, masonry work, plumbing, and electric wiring. Specifications may be seen and all information obtained at the office of the superintendent of buildings, 155 College St.

Toronto, Ont.—The Jefferson Glass Co. will erect factory at 388 Carlaw Ave. Estimated cost, $7,000.

Toronto, Ont.—The Blatchford Calf Meal Co., of Waukegan, Ill., is establishing a factory in Toronto, and will operate under the name of Blatchford Calf Meal Co. of Canada, Ltd. J. W. Barwell, president, Waukegan, Ill. Details regarding the Canadian plant are being arranged by the company's vice-presidents, W. L. Blows and H. C. Burnette, Waukegan, Ill.

Toronto, Ont.—Site has been purchased by the city for $123,150 on Bathurst St. for hospital for insane.

Truro, N.S.—The board of directors of the Truro Protestant Orphanage have decided to call for tenders for the demolition of part of the present buildings and construction of a new wing.

Winnipeg, Man.—It is estimated that about $2,000,000 will be expended this year on building between three and four thousand homes in this city.

Winnipeg, Man.—Tenders will be received by C. J. Brown, City Clerk, Winnipeg, until 3' p.m., July 28th, for the supply of all labor and materials required for the erection of a show room building for the city light and power department, on Princess St. Plans, specification and form of tender may be obtained at the office of J. J. Chisholm & Son, architects, 703 Great West Permanent Building.

Winnipeg, Man.—Tenders will be received by M. Peterson, secretary, committee on finance, city clerk's office, Winnipeg, Man., until 3 p.m., July 30th, for alterations and additions to the central market building, to convert same into civic offices. Plans and specifications and form of tender may be obtained at the office of the building inspector, corner James Ave. and King St.

MISCELLANEOUS

Buckingham, Que.—The department of public works, Ottawa, contemplates reconstruction of wharf.

Calgary, Alta.—Tenders will be received until July 31st for construction of concrete pier and circle wall for turntable. Canadian Pacific Railway station superintendent.

Chatham, Ont.—The city council has decided to purchase an asphalt paving plant to be used in repairing pavements. Estimated cost, $18,883.

Collingwood, Ont.—Construction of breakwater costing $50,000 is contemplated by the department of public works, Ottawa.

Eburne, B.C.—Improvements to bridges are contemplated by the provincial government. It is proposed to install electric lighting and motors to work main drawbridge.

Edmonton, Alta.—Contract for clear water basin has been awarded by the city commissioners to Swanson and Kaline.

Esquimalt, B.C.—The Dominion government engineers are taking the necessary borings preliminary to active construction on the new drydock. It is expected that construction work will soon be under way and rushed to completion. Engineer, Davy, Esquimalt, B.C.

Fairview, B.C.—The Provincial government has awarded the first contract to construct irrigation flumes and ditches in connection with the soldiers' land project in Southern Okanagan district to A. E. Griffen & Co., Vancouver.

Grosse Isle, Que.—Sealed tenders will be received until 12 o'clock noon, August 5th, by the department of public works for construction of an extension to the eastern wharf at Grosse Isle Quarantine Station. Plans, etc., may be obtained from the district engineer, Montmagny, Que.; postoffice, Quebec, Que., and the Shaughnessy building, Montreal, Que. R. C. Desrochers, secretary.

Kincardine, Ont.—The department of public works has awarded contract for dredging to The C. S. Boone Dredging and Construction Co., Ltd., Toronto.

Kingston, Ont.—The department of public works, Ottawa, has awarded contract for stone rip-rap along south walls of Lasalle highway to John F. Sowards, Kingston. Contract price, $7,950.

Laprairie, Que.—$82,000 will be expended by the department of public works for protection work.

New Massett, B.C.—The department of public works, Ottawa, has awarded contract for wharf to W. T. Muse, Prince Rupert, B.C.

North Battleford, Sask.—The citizens' committee contemplates erection of aerodrome.

Okanagan Centre, B.C.—The department of public works, Ottawa, will receive tenders until August 5th for construction of public wharf. R. C. Desrochers, secretary.

Ottawa, Ont.—Tenders will be received until 3 p.m., July 29th, by the board of control, city hall, Ottawa, for the construction of foundations and installation of a 20-ton weigh scales in the By Ward Market. Wm. Borthwick, market inspector.

Port Hope, Ont.—Contract for repairs to pier has been awarded by the department of public works to R. Brewder, Cobourg.

Powell River, B.C.—Tenders will be received until noon, July 31st, by R. C. Desrochers, secretary, department of public works, Ottawa, for the construction of an addition to the wharf and dredging at Powell River, District of Comox-Alberni, B.C. Plans and forms of contract can be seen and specification and forms of tender obtained at the department of public works; at the offices of the district engineers at Westminster, B.C.; Victoria, B.C.; at the post-offices, Vancouver, B.C., and Powell River, B.C.

Princess Creek, B.C.—Wharf costing about $7,000 will be constructed here by the department of public works.

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C E.—7-24-19

Port Arthur, Ont.—The department of public works, Ottawa, has awarded contract for breakwater extension to Chambers, McQuigge and McCaffrey Co., Ltd., Toronto. Contract price, $684,000.

Port Elgin, Ont.—Sealed tenders will be received by the department of public works, Ottawa, until 12 o'clock noon, August 5th, for repairs to wharf and partial reconstruction of breakwater. Plans and specifications may be obtained from the district engineer, Toronto, and from the post-office, Port Elgin, Ont. R. C. Desrochers, secretary.

Scotch Cove, N.S.—No contract for breakwater extension has been awarded by the department of public works. The work will be done by day labor.

Shippigan Gully, N.B.—Tenders will be received until noon, August 5th, by R. C. Desrochers, secretary, department of public works, Ottawa, for repairs to breakwater at Shippigan Gully, Gloucester County, N.B. Plans and forms of contract can be seen and specification and forms of tender obtained at the department of public works, Chatham, N.B.; St. John, N.B., and at the post-office, Shippigan Gully, N.B.

St. Michel de Bellechasse, Que.—J. B. Gallibois, St. Pierre, Que., has been awarded contract for repairs to wharf by the department of public works.

Toronto, Ont.—A system of life-saving stations will probably be established immediately by the city of Toronto. The Dominion government has agreed to give $20,000 towards capital expenditure and $3,000 per year maintenance. The board of control has recommended an annual expenditure of $30,000. The Harbor Commission will also expend $3,000 per year toward the same project.

Toronto, Ont.—The Toronto Harbor Commission will construct a new wharf at the foot of Hiawatha Ave., Centre Island, Toronto, and rent same to the Toronto Ferry Co. Ltd. Approximate cost, $6,000. E. L. Cousins, chief engineer.

Toronto, Ont.—The board of control will construct temporary breakwater protection for the eastern beaches this summer.

Toronto, Ont.—Tenders will be received by T. L. Church, chairman, board of control, until noon, July 28th, for the construction and delivery of 20-inch cast-iron pipes and valves for St. Clair Ave., from Keele St. westerly, and for laying of same. Specifications and tender forms for the foregoing may be obtained upon application at the office of the water main extension section, department of works, room 320, city hall, Toronto.

Vancouver, B.C.—Water out of Roberts Creeks, draining into the Gulf of Georgia, will be diverted for irrigation purposes by L. H. Roberts.

Winnipeg, Man.—The department of public works, Ottawa, has awarded contract for alterations and additions to service building at the Military Hospital to Carter-Halls-Aldinger Co., Ltd., Winnipeg, Man. Contract price, $29,000.

Yorkton, Sask.—The plumbing and heating contracts for the new court house has been awarded to Whiteford Bros., Regina. Contract price, $13,500.

Tenders Called For

TENDER FOR SEWERS

Tenders, sealed and marked, will be received by P. J. Anderson, Clerk, Newmarket, up to noon, August 7th, for the construction of storm and sanitary sewers in the town of Newmarket.

Plans and specifications may be seen at the office of the engineers, James, Loudon & Hertzberg, Limited, 36 Toronto Street, Toronto, or at the office of the Clerk, Newmarket.

The lowest or any tender not necessarily accepted.

W. EAVES, Mayor P. J. ANDERSON, Clerk.
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C. J. YORATH,
City Commissioner.
July 18th, 1919. 304

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The Canadian Engineer

A Weekly Paper for Civil Engineers and Contractors

Construction of Water-Bound Macadam Roads

How To Prevent Their Destruction By Modern Automobile Traffic Proves a Serious Problem for the Highway Officials of Quebec Province—Translation of Paper Read in French Before the Canadian Good Roads Association

By A. PARADIS
Assistant Engineer, Department of Roads, Province of Quebec

SINCE the inception of the good roads movement in Canada, macadam has been the type of pavement most generally adopted. The paving methods of Macadam and Tresseillet had acquired great popularity in Europe, and, like a good many other progressive ideas, soon drew the attention of the American nations.

It did not take long for the provincial governments (at least for the Quebec government) to grasp the opportunity offered by this type of pavement for the betterment of rural roads in Canada. In this province the proposition was rapidly thought out, and was developed at a rate of approximately 400 miles per annum, since 1913. The Province of Quebec owns, at the present time, approximately 2,500 miles of macadamized and gravel roads. The pace does not seem to diminish, but a new problem, somewhat difficult and full of unknown factors, presents itself. It is that of up-keep of water-bound macadam.

The extraordinary development of commerce, industry and agriculture in the last twenty-five years have naturally revolutionized the transportation methods considered sufficient up to that time. It was considered sufficient up to that time to maintain the exchange of merchandise and of movement of traffic. At present, however, industry is becoming decentralized, spreading out around the cities and reaching even the small country villages. The distributor wishes to cover with his goods the largest possible area in the minimum length of time. Intensive and up-to-date farming necessitates the immediate distribution of farm products to the cities. The railways, excellent as they are for transportation in large quantities, do not provide a sufficiently detailed distribution.

The whole of commercial life has seized the advantage offered by the development of the automobile and auto truck industry to enlarge the radius of its businesses, and to add to pleasure trips. This entails boundless competition. As soon as good roads are developed and multiplied, truck traffic increases in density, and speed craze appears. Passenger automobiles ply between Montreal and Quebec, and are now reducing the time necessary for the same trip by railway.

Cannot Carry Heavy Traffic

The strength of water-bound macadam is not sufficient to bear the heavy loads, which seem to increase endlessly. The blows of auto tires running at 35 or 40 miles an hour, tear out the surface stones and leave voids which promptly grow larger. Against these multiplied factors of disintegration, it seems as though macadam will have to be given up on most highways. A good many efforts have been made to solve the practical problem of the up-keep. None of the proposed solutions have been entirely satisfactory. This is so much the case that, in engineering circles, one no longer hears anything but concrete, bituminous macadam, bithulithic and Warren pavements, etc. All these pavements have deserved the somewhat pompous title of "Superior Pavements." They are indicated from every point of view on main highways, and in the vicinity of cities, but on account of their very high first cost they are not suitable for roads of purely local importance. All the roads which serve as tributories of the main highways, towards farms and villages, come in this latter class, and as the provincial government, which controls paving programs, is much interested in the welfare of the farmers, it is practically certain that at least 50% of the mileage that will be constructed will be water-bound macadam.

Estimate of Annual Cost

Even if one leaves out all the factors of preference and if one considers good roads as a purely economical problem, the kind of construction that will be adopted under certain given conditions will depend on the annual expense for up-keep for the different kinds of pavement proposed. That is to say, the yearly interest on the capital to be expended, the yearly cost of up-keep and sinking fund. Taking for example a concrete pavement costing $20,000 a mile, with probable up-keep expenditure of $75 per mile per year, and a sinking fund period of, say, thirty years, interest being figured at 5%, and comparing this with a water-bound macadam whose first cost would be $7,000 a mile, and up-keep cost of $300 per mile per year, with a sinking fund period of ten years, interest rates being the same in both cases, a little calculation shows us that the yearly cost of delivery of the concrete road will be $1,376 a mile and that of water-bound macadam $1,206 a mile, showing a difference of $170 per mile per year in favor of water-bound macadam.

Under such conditions as outlined above, macadam should in every case receive favorable consideration as against concrete. This logic cannot be side-tracked, but, a difficult problem is to arrive at the proper factors which vary widely both as to yearly up-keep and as to sinking fund period. Figures which statistics and experience seem to favor to-day as a rational basis for estimates will in a few years be replaced by others widely different because at that time the traffic conditions will have changed and construction methods will be much improved. However, the proposition remains the same, and although certain factors of the problem may change, the theory will remain the same. We can foresee the capitalization as based on the present data will favor water-bound macadam for roads of local importance, and that a good many milions will yet be expended to extend and complete the system of macadam roads in the Province of Quebec.

We know, also, that considerable sums will have to be put aside for the up-keep of these macadam roads. Under these circumstances we may be sure that the provincial and municipal authorities will give a good deal of attention to this type of construction, and the engineers of the Department of Roads of Quebec are working towards a more perfect solution of the problem of construction and up-keep of water-bound macadam. Our climatic conditions and the nature of the available materials differ so widely from those of Europe that although European countries are ahead of

us in road building, we cannot follow here the methods currently used in France and England. Even among American and Canadian engineers we find quite a diversity of opinion on this subject. This is quite natural, as we cannot suppose that speaking from personal experience the New York engineer will have the same ideas as the man who has been building roads around Lake St. John. This is due, of course, to sub-soil conditions. The autumn rains and the intense colds following thereafter, place the Province of Quebec in an unique position which cannot even be compared with that of the states of Vermont and New York close by.

Quebec Problems Different

Quebec roads must be studied, free from all theories obtaining in other countries. We know that the provincial department of roads has always given its full support to the experiments of their engineers. The special conditions found in our province are: Firstly, the heavy winter frosts which penetrate several feet into the earth and cause heaving. Secondly, the nature of the materials to be found locally and which must be used to the best advantage. We cannot here go extensively into these two subjects. Let us remark, however, that water-bound macadam, having relatively little elasticity and small resistance to shearing stresses, suffers considerably from the disturbances caused by frosts. The only way to obviate, to a certain extent, this disintegration is to keep away from the roads the water resulting from the autumn rains.

Drainage, therefore, plays a very important part in this work and neglect of ditches and curbs will entail much more serious consequences than is generally known. However, in a good many cases the drainage is not sufficient to prevent infiltration, and in these cases means must be taken to catch the water before it penetrates under the road.

Water penetrates through the shoulders from ditches when their grade is poor, and even sometimes from the surrounding land, especially in cuts.

The construction of a longitudinal drain below the foundation will intercept the water and maintain the road in a sufficiently dry state, and so nullify the action of frost. The cost of these drains put down after the method adopted by the Department of Roads of Quebec is approximately 25c. per lineal foot, and increases the cost of construction of macadam roads approximately 10 or 15% for a drain on one side only. This relatively high cost is probably the reason that drainage has not been more extensively adopted in municipal road work. It is, however, recognized that under the very unfavorable circumstances, drainage must be used to avoid the necessity of reconstructing the macadam surface every spring.

Field Stone and Limestone

Field stone is most usually employed in the construction of water-bound macadam in Quebec. Quarries are not usually sufficiently scattered, and the cost of transportation is, as a result, too high to permit the use of quarry stone on road construction in all parts of the province. Besides, nearly all our quarries produce limestone, for example, the quarries of Montreal, Quebec, Deschambault and Joliette. These limestones are homogeneous and free from defects and mesh very well, but experience seems to show that they are not sufficiently hard for the necessary resistance to wear for heavy traffic. However, for roads of purely local importance, which are exactly the ones that should be built with water-bound macadam, these limestones should be used wherever their cost is comparable to that of field stone.

Despite the advantage of limestone, it can be foreseen that field stone will be mostly used in macadam roads. It can be found anywhere, and the use of it for road work enables the farmers to get rid of the rock heaps often to be found in their fields, which interfere with ploughing and harvesting. Field stone, as a result, is a mixture of different crystalized blocks, with granite and gneiss predominating. It is usually hard but somewhat brittle, and almost entirely lacking in the mesh qualities which characterize limestone and schist.

It would be difficult to make a careful choice of the various kinds of field stones scattered in small heaps in various farms, and in order to lower the cost of transportation, the best procedure is to use stone close to the road. Stone which is evidently of an inferior quality can be discarded before crushing. The discard will usually be small and comprise only stone too soft to be used for the wearing surface.

It is to be hoped that the installation in the various municipalities of permanent up-keep gangs and foremen will enable this selection of stone to be made in the winter.

Macadam, as invented and practiced by the originators of this system of road building, was meant to have a smooth, hard surface, and the union of the stone should be sufficiently effective to render the wearing surface almost as hard as concrete. European nations have come close to this idea, and the French people especially find it quite natural that a water-bound macadam road should give them 15 or 20 years of hard service without the necessity of resurfacing.

European Methods Not Applicable

Let it be well understood, however, that the European procedure cannot in every case be applied to Canadian roads. In France the abundance and low cost of labor enable the crushing to be done by hand, at least for the surface course. They attain in this manner carefully selected stone, practically cubical in shape, and varying in size only from 1½ ins. to 2½ ins. This is quite different from the product of crushers which often give flattened stone with sharp angles easily broken up under the roller, which enlarges the proportion of small pieces. It must not be said, however, that these defects of jaw crushers necessitate a revolution in our system of road building. This country is young, labor is scarce and consequently to be spared whenever possible. We must therefore substitute machines. Even with the high salaries latterly paid, the cost of crushing has hardly exceeded 50c. per cubic yard.

We must calculate therefore on the principle that we must make the best of the situation as we find it, as the aim is to better the crushing and so to grade and crush stone as to introduce here, as much as they may be applicable under our conditions, the processes which experience has proven to be most efficient in other countries.

The three principal points to be carefully watched in crushing are the speed of the machines, the renewing of worn-out jaws, and a proper arrangement of screens for grading. It is easily seen that speeding up the crushers means that stone crushed to the proper size in the upper end of the jaw will be crushed once again before getting out of the bottom, and this will result in too many small fragments. It is therefore necessary to choose a crushing speed which will prevent this, and will at the same time be sufficiently fast to give an economical output. The high price of jaw blades, which has become exhorbitant in the last year, has resulted in the use of worn jaws (by some contractors and foremen) until the jaws are perfectly smooth. Flat stones can therefore pass through the crusher and make their way to the screen in sizes which cannot be used.

It is therefore essential that jaw blades be carefully inspected, and a good foreman will not await orders of the engineers to replace these when they are worn out.

Small Stones Undesirable

Careful attention to the first two points will practically eliminate the third. It can easily be seen that by diminishing the proportion of small pieces, narrower limits as to size can be set down, and we would thus use for the wearing surface nothing but stones from 1½ to 2½ ins. This can only be done provided that there is not too much reject and that the small stones from ¾ to 1½ ins. will prevail only in sufficient quantity to be used up as filling material in the foundation courses.

The undesirability of small stones is very apparent when one knows how difficult it is to maintain a good bond on roads macadamized with field stone. It is easily seen that the force exerted on macadam surfaces by passing vehicles is the resultant of two forces, one (vertical) being the weight of the load, the second (horizontal) being the tractive effort of the vehicle. These two forces are very variable. In the case of an automobile travelling at high

speed, the horizontal force becomes very high and tears out the stone and destroys the bond of the surface. In the case of a steam roller, the vertical force is much more apparent and therefore the roller is employed to rebuild the surface which the horizontal force destroys.

It is out of the question to restrict the speed of automobile to a point where they will not be harmful. The only solution is to offer to the pneumatic tire the solid surface with not only the necessary hardness but also the necessary weight and tensile strength.

The larger the stones composing the surface, the better the contact with adjoining stones and the more the macadam will be compact and massive. The means mentioned above for reducing the proportion of small stones, will help considerably towards the desired result. The limit as to the size of stone which will permit a sufficiently smooth surface for present vehicles is approximately 2½ ins.

Use of Limestone Dust

Another method of lengthening the life of macadam and at the same time diminishing the up-keep cost of field stone macadam, is to use limestone dust as a binder.

There is in the Parish of St. Jean-Chrysostome, in Chateauguay County, a road built in 1913 with field stone and a limestone dust binder. This road has carried continually very heavy traffic, and in addition carries the transportation of stone for the construction of surrounding roads. In 1918, after five years of continuous service, there were no apparent ruts and no loose stones, although the crown of the road has almost entirely disappeared through wear.

The value of a limestone binder in connection with field stone is pretty generally recognized, but fear is often expressed that the advantage to be obtained will not be proportional to the extra expense due to the purchase and transportation, often for long distances by rail, of this limestone dust, which cannot be obtained outside of quarries. If we take it that the quantity necessary for good results is equivalent to a layer ¾ in. thick, the necessary quantity for one mile of 12 ft. road would be 146.6 cubic yards, and as we may reasonably suppose an average cost of $3 a yard, the cost of the road would be enhanced by $440 a mile, which is an increase of 6.3% in the cost of a road costing $7,000 per mile.

If we now take it that by the use of this process we succeed in lengthening by 20% the life of the macadam, it will be economical to use this dust. We see in this way that the reduction in up-keep cost would more than cover the interest on the additional capital used up in the construction.

Limestone quarries are unable to furnish in large quantities this binder, which consists of particles varying from ½-in. to the finest dust. In some parts of the province this dust may be obtained in its natural state. The binder which was used on the above-mentioned road in St. Jean-Chrysostome, was found right in the parish and so close to the road itself as to be quite economical.

Common Errors in Construction

It is often found in practice that a number of mistakes and omissions occur in the detail of construction as written in various specifications generally used at the present time. We must recognize that specifications, however elaborate, offer always sufficient leeway that the contractor may use his personal views and methods. I think it advisable to enumerate here certain methods frequently found which seem really bad, and the suppression of which would bring us nearer to the methods in use in European countries, which possess at the present time the finest roads in the world.

Certain foremen and contractors have the habit of considering in every case crusher dust as a binder. This error is due to a false idea of what takes place in the interior of the macadam during rolling. Under the pressure of the roller, the stones mesh themselves as to produce strong friction between the surfaces in contact. This friction produces a very fine dust which is the best possible binder when the stone possesses binding qualities. This binder will be very efficient if sprinkling takes place at the same time.

Stone which will not bind without previously filling the voids will not bind any better with its own dust. In filling the voids with dust before rolling, one may obtain a macadam with an apparently compact and even surface but which will disintegrate in a few dry days. However small the proportion of binder in the stone, the macadam must be watered and rolled, but never rolled dry until the macadam is very compact and the voids reduced to a minimum. This is the time to spread crusher dust to fill what voids may remain, and thus render the surface still more compact and sufficiently impervious to water.

Must Apply Small Quantities

We must, however, make one exception. This is when limestone dust is used as a binder. Limestone must be applied in successive very small amounts as soon as the rolling begins in order to enable the limestone dust to penetrate gradually between the stones. This operation must be watched in order to prevent the application of an excessive dust at the beginning of the rolling.

We witnessed some years ago a typical case showing the undesirability of an excessive dust in the macadam. A contractor in perfectly good faith had gotten the habit of placing all the crusher dust, including the small fragments up to ¾-in., in the last layer of stone. In order better to obtain this result, the dust was spread before any rolling over the stone, which was entirely covered. Be it noted that the stone was of good quality and contained sufficient binder to give results. Nevertheless, it was only after prolonged rolling, renewed at intervals after several weeks, that he was able to obtain a satisfactory bond. One could, however, see at the same place a piece of macadam built the previous year in the same fashion, which showed a rough and uneven structure which could not be charged to wear, age or heavy traffic.

One might claim to upset this principle by showing a new macadam built after this style and sufficiently bonded. This would merely show that the stone employed was very easily bonded, and in any case the argument would only last for the time necessary for traffic and wind to destroy the layer of dust with which the surface of the macadam is camouflaged.

Cannot Interrupt Sprinkling

Another very common error in construction consists of carrying sprinkling water a considerable distance in the sprinkler itself. This means that sprinkling is interrupted for considerable intervals, during which the rolling continues under unfavorable conditions. We must not forget that the water is one of the principal materials in the construction of macadam, and although it may be true that certain limestones bind fairly well when dry, it is also true that this bond will be much more effective if treated with water at the proper time and in sufficient quantities.

It has often been noticed that in clay regions the surface of a macadam road is deteriorated for 200 or 300 ft. at each end by the clay which the wheels of vehicles spread on it. This defect which everybody sees and which is considered almost inevitable, could be much diminished by proper precautions and principally by ending the macadam with special care. Last year there was to be seen in the Parish of St. Malachie, in Dorchester County, a macadam two years old which had kept its shape and surface without any deterioration up to the point where it joined a clay road. The contractor who built this road was an artist in road construction. Would that he might have many disciples!

The up-keep of macadam roads in Quebec began two years ago, when the first signs of deterioration and of wear appeared in the roads constructed in 1912 and 1913. Two years are very short to study a problem which can only be solved through experience. It is not easy to obtain at the present time a general rule which will apply to the special conditions in our province. There are, however, certain causes of deterioration of macadam which leave no doubt as to the best measures to retard and nullify their effects.

Frost, for example, disintegrates more or less all macadam roads. This is not surprising, since the effect of frost can be seen even on solid roads. We can, therefore, adopt the practice of rolling anew every road each spring as soon as the frost has disappeared. We must not forget that this rolling must be preceded by the ordinary sprinkling. Sometimes the sprinkling may be avoided if the weather is rainy at the beginning of the summer, but it is not advisable to delay this work too long awaiting rain. The cost of rolling and sprinkling might reach approximately $100 a mile per year.

The heaving of the soil produces blisters which are a cause of rapid deterioration. These can be eliminated by drainage. If the system of drainage employed during the construction of the road has been insufficient to keep the road from infiltration, some means will have to be devised to eliminate water from the affected spots. Tile drains are usually advisable in these cases.

The cleaning out of the ditches and curbs is imperative each year and should be done in the first days of spring, before vegetation gets a chance to take root. In flat country, such as the land to the south of Montreal, at Laprairie, Chateauguay and Huntingdon, it often happens that

(Concluded on page 193)

MUNICIPAL ENGINEERS AND TOWN PLANNING

By Thomas Adams
Town Planning Adviser to the Housing Committee of the Dominion Cabinet, Ottawa

THERE was a time in Britain when the engineer looked somewhat askance at town planning and regarded it as sort of a fanciful idea promoted by impracticable idealists. The period of this attitude ended about 1911 when the town planning act became really operative and engineers began to take up the subject as a part of their daily practice. Ever since then the annual meeting of the Institution of Municipal and County Engineers has included one or more papers on town planning in its program and on two or three occasions has dealt almost exclusively with town planning as the subject for discussion at their annual meeting. Such eminent municipal engineers as John Brodie, of Liverpool, and H. E. Stilgoe, of Birmingham, are prominent members of the council of the Town Planning Institute, and have promoted, in their own cities, town planning schemes for most of the undeveloped building land.

The last annual meeting of the institution was held June 26th to 28th, in Birmingham, under the presidency of Mr. Stilgoe. This is the last occasion when Mr. Stilgoe may preside as a city engineer, since he has been appointed as chief engineer of the Metropolitan Water Board of the County of London.

At the Birmingham meeting, a town planning paper was presented by James Thomson, the city engineer of Dundee. Its subject was "Housing in Relation to Town Development." Mr. Thomson indicated the connection between housing and town planning from the standpoint of the engineer, and how the fact that they were inseparable parts of well considered schemes of expansion made them pre-eminently engineering questions. He pointed out how the absence of any comprehensive plan has produced disastrous effects to amenity and housing conditions. Plans of development, he suggested, should sufficiently meet not only the present-day requirements but also the needs of every locality for a period of not less than 50 years.

Mr. Thomson indicated the following main proposals which local authorities should consider in relation to housing and land development:—

(1) Absolute change from the present method of town growth as one mass without intervening spaces.

(2) Acquisition at every opportunity of undeveloped land at as near its agricultural value as possible.

(3) Design of the frame work or skeleton of all existing and proposed main roads, excluding subsidiary roads, within a well-considered probable extended boundary.

(4) Limitation in the size of all new combined industrial and housing areas to a maximum to be fixed by the local authority.

(5) Separation of all new combined industrial and housing areas from each other, and from existing areas by open spaces and wooded belts.

(6) Complete revisal of former methods of lay-out of land for working-class dwellings.

(7) Drastic change in the design, type, size, equipment and environment of houses for the working classes.

(8) Reduction of housing density.

(9) Sufficiency in all housing schemes for gardens and allotments and facilities for culture.

(10) Certainty that in all new works areas, housing shall be carried out on town planning lines.

(11) Allocation to each new housing and industrial area of sites for buildings necessary for culture and recreation facilities.

(12) Facilities in every new housing unit for out-door recreation for adults and children.

(13) Increase in the number of small parks corresponding with the increase in number of housing areas.

(14) Transit facilities to outlying districts and to all new industrial and housing areas.

(15) Abolition, step by step, of all slum areas.

(16) Improvement by degrees of central area and of all congested districts.

(17) Gradual widening of central main streets and the early widening of portions of arterial roads in the outskirts.

(18) Preparation of town planning schemes for all areas proposed or brought within boundaries in conjunction with town planning of areas within the existing town.

(19) Extension of railways and provision of railway sidings into land to be used for industrial purposes.

(20) Appropriation of sites for landing grounds in anticipation of the introduction of aerial transport in conjunction with the fixing of housing and industrial areas.

Mr. Thomson pointed out that as expansion of cities took place, the necessity of a combined scheme of housing and development became more and more necessary.

Cities would continue to grow as formerly and would consist of an aggregation of houses, industrial buildings and streets massed and expanding without method. He claimed that there was a large responsibility resting upon municipal engineers to prevent the laying out of roads "insufficiently wide and illogically placed, public buildings erected without regard to suitability of site, traffic and transport convenience neglected, and, generally, a haphazard accumulation of all that goes to make a town unattractive and depressing."

We have still some progress to make in Canada in getting the municipal engineers to take such an active part in promoting town planning as they seem to be doing in Great Britain. Now that we are gradually getting the needed legislation, it is certain that engineers will give more attention to the subject.

One of the directions in which we need to make progress in Canada is in providing more education in our universities to engineers and architects on town development, and it is hoped and expected that this defect will be made good in the near future.

In connection with housing there is a tendency in Canada to promote schemes of building houses on vacant lots in parts of the cities that are already in course of development. This does not give the engineer who has ideas, any opportunity of assisting in securing an efficient and economical system of building houses and laying out local improvements—matters which go together.

One of our tendencies is to have stereotyped rules fixing width of streets and other things in connection with land development, leaving no initiative to the engineer. The time has surely come when the members of the engineering profession who specialize in municipal work should get together and co-operate, with a view to giving more influential direction to some of the problems of town development. We have just as great problems as they have in Britain and, being a new country, we have better opportunity to solve them.

STUDIES IN THE BACTERIOLOGY OF WATER*

By Denis B. Wood

IT is well known that bacteriological examinations of water supplies are directed to the detection and enumeration of what are known as "indicator organisms"—that is to say, organisms which are always to be found in large numbers in the excreta of man and animals. The presence of such organisms in water indicates potential danger to the health of consumers, for individuals suffering, or having suffered, even at some remote time, from typhoid fever and kindred diseases may void the specific organisms in large numbers in their excreta.

Contamination of water with excretal matter derived from animals is of less potential danger, for the lower animals are not to anything like the same extent subject to these diseases. They are known, however, to be subject to infection with the Gäertner group and paratyphoid bacilli, and with animal parasites, though such infections are rare, and contamination with animal excretal matter must be regarded as undesirable. Moreover, as we have as yet no means of distinguishing between contamination with human and animal excretal matter, so similar are their bacterial flora, we are obliged to take a safe course and regard all waters showing definite evidence of excretal contamination as more or less unsatisfactory.

There are three groups of "indicator organisms": (1) The B. Coli group, (2) the Streptococcus group, and (3) the Enteritidis Sporogenes group. The average numbers in which they are present in one gramme of human fæces are:—

B. coli.	Streptococci.	Spores of B. Enteritidis Sporogenes.
100-1,000 million.	100-1,000 million.	1-10 million.

It is evident, therefore, that tests based on the enumeration of B. coli and Streptococci will be the most sensitive. In this paper only these two groups will be considered.

The B. Coli Group

Members of the B. coli group have one characteristic in common—viz., the fermentation of lactose with production of acid and gas. The study of this group reveals the fact that it can be divided and subdivided into a number of types.

From MacConkey's result it appears that 87% of the lactose-fermenting organisms present in human fæces all produce indole, acid and clot in milk, do not liquefy gelatine nor give the Voges and Proskauer reaction. In other words, they possess, practically speaking, the cultural characters of Houston's "typical B. Coli." Houston found that about 85% of the lactose fermenters present in human fæces, and 65 to 85% of those present in sewage, possessed these characteristics.† The results of his investigations on the viability of members of the B. coli group in soil and water show that the atypical varieties persist for longer periods than the typical, and are therefore less characteristic of recent contamination. Houston's definition of typical B. coli is admirably suited to routine bacteriological examination, and has been very generally adopted as a basis for bacteriological reports.

The Streptococcus Group

It sometimes happens that in a water examination only lactose fermenters having the characteristics of Houston's "typical B. coli" are to be found. It is then a great advantage to have recourse to another test, and the most satisfactory corroborative test is based on the enumeration of streptococci. Savage and Read have shown that the majority of waters showing evidence of contamination on the B. coli basis contain streptococci.

In calculating percentages nothing is to be gained by working out the percentage of water-samples which contain streptococci or B. coli respectively in the different amounts. The percentage results are worked out in two ways. In one way each group of B. coli prevalence is taken separately and the percentage prevalence of each group of waters on a streptococcus basis is calculated. In the other way each group of streptococci prevalence is taken separately, and the percentage prevalence of the waters on a B. coli basis is recorded.

An example will make this clear. Take, for instance, 118 samples from deep-water supplies containing B. coli in 10 or 30 cm.; 58 or 49.2% contained no streptococci. Or take the 198 samples from deep-water supplies containing no streptococci; 64 or 32.3% contained B. coli. The mean of these two numbers (49.2 and 32.3) is 40%, and gives a fair average of the number of samples in which B. coli may be present in only moderate numbers and streptococci absent. In other words, the chances are rather more than even that streptococci will be found, and if not found in one sample they probably will be in the next, or at any rate in subsequent examinations. This correlation between B. coli and streptococci is a point the author particularly wishes to emphasise. Apparently the value of this test as carried out by Savage has not been fully appreciated.

The streptococcus group can also be differentiated into a variety of types by fermentation reactions; those producing acid in lactose are particularly typical of excretal contamination. Differentiation of this group, however, is seldom practised.

Index of Recent Contamination

The streptococcus enumeration is particularly valuable as an index of recent contamination. This was shown by the results of an investigation carried out by the present author in conjunction with Dr. W. G. Savage on the relative viability of B. coli and streptococci in water under conditions closely resembling those of a well. In this investigation an earthenware pipe cemented at the bottom and holding about 40 litres of water was used as the model well. The water was contaminated with excretal matter emulsified with water, or with sewage, and examinations were made at regular intervals to ascertain how rapidly the organisms diminished in numbers and finally disappeared.

These experiments with excreta or sewage added to a large bulk of water yield minor differences in the individual experiments, but in general they show a rapid diminution and elimination of the streptococci and a continuous, yet not quite so rapid, diminution in the number of B. coli.. With the latter it was more common to find persistence in small numbers for a period extending to many weeks. The elimination of the streptococci was particularly uniform and rapid. At the end of three weeks in only two experiments were they present in more than insignificant numbers.

The decline curves of both organisms agree very closely, as could be seen most readily when the figures were plotted out as graphs.

Comparison with Typhoid Bacillus

Comparison with the viability of the typhoid bacillus is of special interest. Sir A. C. Houston's investigations in the viability of uncultivated typhoid bacilli in river water showed that they died out within three weeks, even when as many as 38,000 were present per c.c. of the infected water.

Several lactose-fermenting organisms isolated from various sources gave the Voges and Proskauer reaction, very few of which—only 6.3%—were represented in human fæces. These types have recently attracted the attention of American bacteriologists, and have been shown by them to be rare in the excreta of man and animals, more common in sewage and surface water, and the predominant types in soil and grains. They can be distinguished in the laboratory by two tests—(1) the methyl-red test, and (2) the Voges-Proskauer reaction, alluded to above. These two tests are very closely correlated, and by them the lactose-fermenting organisms can be divided into two main types, which are known as—

*From a paper read at the annual summer meeting of the Institution of Water Engineers, England.

†Since the large majority of organisms fermenting lactose and producing indole fulfil the other tests also, according to Houston's later definition, the other tests are dispensed with in routine examinations.

(1) The methyl-red positive type ("M.R.+"), or the Voges-Proskauer negative type ("V.P.—"), and

(2) The methyl-red negative type ("M.R.—"), or the Voges-Proskauer positive type ("V.P.+").

The first is characteristic of excretal contamination, and is sometimes called the "Coli type," while the second is not characteristic, at any rate, of recent excretal contamination, and is sometimes called the "Aërogenes type," after its type organism, B. lactis aërogenes.

These tests commend themselves to the bacteriologist as suitable for routine work in the same way as the tests of Houston, by their simplicity, and are particularly to be welcomed by those in whose experience particular water supplies have yielded only atypical varieties of lactose fermenters according to Houston's definition.

Results show how small a proportion of the lactose-fermenters of excreta belong to the "M.R.—" type, and how large a proportion are present in soil and grains. Occasionally a specimen of fæces contains a fairly large proportion, the high figure of 26% obtained by Rogers, Clark and Lubs was due to a single abnormal specimen, and to the employment of a method specially selected to favor the growth of this type, and does not represent the average numbers in which they were actually present.

Methyl-Red Negative Organisms Survive

Records of various observers strongly suggest that organisms of the "M.R.—" type are the more resistant, the more capable of surviving outside the animal body, and of finding a favorable environment in soil.

Winslow and Cohen carried out experiments on the relative viability of these two main types in water, and their results show that there is distinct evidence that the viability of the "M.R.—" type is greater than that of the "M.R.+" type.

Experiments show a decrease in the "M.R.+" type from 50 to 5%, and from 56 to 0% respectively (in sixty days). On the average, however, the reduction in the percentage was from 54 to 29.

As the methods employed by American bacteriologists differ in some respects from those usually employed in this country, it was thought advisable to investigate how frequently organisms of the "M.R.—" type were likely to be encountered in the routine examination of waters by English methods, and, by noting the association or absence of association with streptococci, to ascertain whether the presence of lactose-fermenting organisms of this type affords evidence of recent excretal contamination or not.

Observations were therefore made by the author of a large number of samples of water from various sources. Out of 200 samples in which lactose fermenters were present, organisms of the "M.R.—" type were encountered in 66, or 33%.

Lactose fermenters of the "M.R.+" type and streptococci were absent from practically every sample, strongly suggesting that in general no recent excretal contamination had occurred, for if it had streptococci would have been found in about 50% of these samples. [These samples were of water of good repute.]

Other samples from shallow wells, etc., were as follows:—

Samples from Shallow Wells

(1) Those containing no streptococci and no lactose fermenters of the "M.R.+" type, suggesting no recent contamination.

(2) Those containing streptococci and probably lactose fermenters of the "M.R.+" type also, though, since contamination was sufficiently proven, further search for this type was not made.

(3) Those containing streptococci and lactose fermenters of the "M.R.+" type, further search having been made for this type for the purpose of this investigation.

It may be asked, How is it that the "M.R.—" type are found in samples of groups 2 and 3 in which recent excretal contamination is proved? The explanation obviously is that a certain amount of self-purification has already taken place, but the contamination is sufficiently recent for organisms of the "M.R.+" type and streptococci to be present also in larger quantities of the sample.

Of special interest was the occurrence of lactose fermenters of the "M.R.—" type in the deep wells in limestone. This supply consists of seven or eight wells, several miles apart, varying in depth from 250-450 ft. These wells yield a very pure supply, lactose-fermenting organisms being absent from 100 c.c. in 85% of all samples examined. In the spring of 1918 lactose fermenters were found in a much larger proportion, and all (with one exception) were found to belong to the "M.R.—" type. Streptococci were invariably absent. The inference is that the most resistant types only of the lactose fermenters reached the underground water, though why they were present in abnormal numbers at this particular time could not be discovered. The only exceptionally heavy rainfall occurred five months previously.

Viability of Capsulated Organisms

The large majority of lactose fermenters of the "M.R.—" type (about 85%) show capsule formation. Experiments by the present author show that some capsulated organisms display remarkable viability in boiled (or steamed) hard water. In one experiment the organism added to such water, containing no measurable trace of saline or organic ammonia, was isolated after a period of three and a-half years. It should be noted that it is only in boiled (or steamed) hard water that such remarkable viability is observed, though in unboiled water some of the capsulated types live longer than the non-capsulated (in one experiment fourteen weeks as compared with seven weeks). The phenomenon seems to be dependent upon the slow deposition of supersaturated carbonate of calcium or hydrate of magnesium, which takes place in the boiled water after filtration. Whether the necessary conditions for prolonged viability occur in limestone silt is a matter worthy of investigation.

Other experiments confirming this remarkable behaviour, one of which was carried out independently by Dr. W. G. Savage, are recorded in the *Journal of Hygiene* Vol. XVI., No. 3, January, 1918. In periods varying from five to eleven weeks, multiplication from fifty to one hundred fold was recorded.

Both strain T. and strain N.D. gave the Voges-Proskauer reaction, and belong to the "M.R.—" type. Strain N.D. produced indole and acid and clot in milk, and was therefore indistinguishable from Houston's "typical B. coli," except by the methyl-red and Voges-Proskauer tests.

Summary

(1) Although attempts to distinguish between human and animal excretal matter by the characters of lactose-fermenting bacilli present have so far been unsuccessful, some measure of success has attended attempts to distinguish between recent and less recent contamination by the identification of the less resistent and more resistant types.

(2) Clemesha based his differentiation on MacConkey's classification; Houston on the more simple indole test. Savage retains the milk-clot test, and notes marked weakness of lactose fermentation, having shown that these attributes tend to diminish with soil environment. American investigators have recently based their differentiation on the methyl-red and Voges-Proskauer tests.

(3) The more resistant the types, obviously, the less evidence there is of recent contamination in waters in which they are found.

(4) Most valuable information as to recency of contamination is afforded by the enumeration of streptococci by the simple method of Savage.

(5) Association or absence of association of lactose fermenters with streptococci can therefore be used as a control in judging the merits or demerits of any of the above methods of differentiation.

(6) Relative absence of association of the lactose fermenters of the "M.R.—" type with streptococci strongly supports the view that they are the more resistant types.

(7) Experiments show that, under certain conditions, the viability of capsulated organisms of the "M.R.—" type may be very considerable. Whether similar conditions occur in nature is a matter requiring further investigation.

METERING AND WATER CONSUMPTION*

By H. P. T. Matte
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In considering the effect of the installation of water meters upon the consumption of water, and in comparing the usage in various cities, three elements, which may have an important bearing upon the results, are seldom taken into account. These are:—

1. Pressure upon the water system.
2. Extent of house connections with sanitary sewers, especially the use of bathtubs and water-closets.
3. Effective size of mains and services.

Pressure of Water System

When per capita rates of consumption are published or mentioned, how often is the average pressure at which the water is supplied included? It is a mistake to omit that item, as it is an important one. A city with a higher pressure than another will find that its leakage rate, both through fixtures and underground piping, will be greater than that of another one which maintains a lower average pressure.

In Oak Park the per capita rate of consumption is easily varied between one and two gallons per pound change in pressure within the entire range of rates of consumption. That is to say, 10 pounds' variation either way will make a difference of 10 to 20 gallons per capita daily. Thus the Oak Park rate of 65 gallons per capita at 45 pounds' pressure can be reduced to 45 gallons at 25 pounds. In Niagara Falls, where the per capita rate of consumption was 300 gallons per diem, exclusive of the industrial usage, the writer determined this rate to be from 3 to 5 gallons per capita per pound change in pressure, or 30 to 50 gallons per capita for each 10 pounds. The Niagara Falls consumption was about 6¼ times that of Oak Park, and the average pressure was about 60 pounds, which accounts for the different limits; but the principle is the same and its importance is clearly seen. The pumping units were designed for a maximum rate of consumption owing to the heavy drafts, and, as there were no small units provided, the effect of reducing the fixture leakage by the installation of meters and the house-to-house inspection was to boost the pressure at night some 30 pounds greater, or to 90 pounds; and the effect of reducing the leakage was not evident owing to the greater discharge of water through the remaining defective fixtures.

The following table shows one of the uses of water affected by pressure:—

A ¾-inch hose 50 feet long with nozzle at 60 lbs. consumes 5,000 gallons per day if in form of jet; at 30 lbs consumes 3,600 gallons per day if in form of jet; at 55 lbs. consumes 10,000 gallons per day if in form of spray; at 30 lbs. consumes 7,200 gallons per day if in form of spray.

These figures have been obtained from tables prepared by Manager Sullivan, of the Nashua, N.H., Water Co.

Connections with Sanitary Sewers

Another element which is noteworthy in its effect on water consumption is the use of water-closets and bath tubs, although the number of consumers on the line of pipes are often considered in computing per capita consumption. It is seldom that the number of consumers which have the use of faucets only are separated from those which have all the sanitary conveniences.

In Oak Park, from numerous experiments, we determined that the average number of gallons per capita consumed by water-closets where no leaks or waste existed was 20; while under the same conditions the average family consumed 15 gallons per capita through bath tubs. An interesting fact connected with the use of bath tubs is that a person who takes cold baths every morning is very likely to consume 40 gallons per day in this item alone. A psychological effect of the lack of pressure, consequently an increase in length of time required to fill bath tubs, oftentimes reduces the quantity of water used for baths.

The records from the following cities show the effect of the installation of sewers upon the general water consumption:—

City.	Before Installation of Sewers.	After Installation of Sewers.
Marlboro, Mass. .	21 g.p.d. per capita	38 g.p.d. per capita
Newton, Mass. ..	31 g.p.d. per capita	63 g.p.d. per capita
Waltham, Mass. .	32 g.p.d. per capita	70 g.p.d. per capita

In Madison, Wisconsin, the per capita daily consumption in residences with sewer conections was 68, while in residences without sewer connections it was 14.

In Rochester, N.Y., services with water-closets consumed 22 g.p.d. per capita; services with water-closets and no baths, 18 g.p.d. per capita; services with water-closets or baths, 14 g.p.d. per capita.

The limited extent of services and sewer connections in foreign cities, thus cutting down the number of outlets for consumption and fixture leakage, is responsible for the low per capita consumption in those cities. From figures obtained three or four years ago, it was noted that the large European cities of over 2,000,000 population had about as many service connections as the average city of 300,000 in this country, while the number of services in foreign cities of about 350,000 population equalled that of our cities of 40,000 population.

Effective Size of Services and Mains

The data on this subject is limited, but difficulty is experienced through loss of pressure by friction from the reduced area of corroded lime-coated service pipes and water pipes filled with algae, crenothrix and tubercles, indicate the importance of the effective size of service pipes and mains on leakage and waste. Water bills on metered premises in which leakage and waste exist often double in size after the renewal of service pipes, both in the ground and in the interior of the house especially when iron pipe has been replaced.

The following table compiled from some experiments conducted by the New York Department of Water Supply, Gas and Electricity, throws more light upon the subject:—

Pressure in street mains required to give the tabulated discharge through a corporation cock and 30 ft. of lead service pipe.

Gals. per Min.	1-in. Service.	¾-in. Service.	⅝-in. Service.
5	.....	2 lbs. sq. in.	3 lbs. sq. in.
10	.....	5 lbs. sq. in.	10 lbs. sq. in.
15	3 lbs. sq. in.	11 lbs. sq. in.	23 lbs. sq. in.
20	5 lbs. sq. in.	18 lbs. sq. in.	38 lbs. sq. in.
25	8 lbs. sq. in.	28 lbs. sq. in.	54 lbs. sq. in.

This table also gives the difference between the pressure at the main and the house side of the service under pressure.

Use of Water Meters

Having considered the items which affect domestic water consumption as governed by local conditions irrespective of industrial and other usually recognized conditions, we may now discuss the meter question.

Can one imagine a gas company or an electric utility selling its commodity without measuring it? Doubtless though, it is easier to tolerate the waste of water because it is not seen or appreciated. Gas leakage is offensive and dangerous. Wasted electrcity is mainfested by motion, light or heat; hut water disappears unnoticed into the sewers. Yet the speaker knows that in an Eastern city where electric-light current was sold under the flat rate system, electric-light bulbs on numerous porches remained turned on all day long. Queries brought the answer that it did not matter as there was no meter. What can the effect be on the water consumer of this type when the water consumption is not metered? In fact, in this same city, which

*Excerpts from a paper read before the annual convention of the Western Society of Engineers.

was only 28% metered, the fixture leakage per capita, as determined by an extended survey, was 205 gallons daily.

Any student of water consumption and waste knows that underground leaks contribute little to the waste included in high per capita statistics. From his experience in Oak Park and elsewhere the writer affirms that the periodical inspection of fixtures in lieu of complete metering is entirely unsatisfactory. When avoidable leakage will occur through meters, what can be expected when there is no automatic check on the consumption?

In Oak Park it has been observed during the past four years that the annual number of high bills complained of, including those places at which the same conditions obtained two or three times a year, dropped from 33 to 10% of the total number of services, due to education of the consumer. Without meters there would have been few complaints and much increase in waste and leakage.

Meters vs. Inspection

It is most difficult to control fixture leakage by inspection on account of the recurring of the waste as soon as the inspection has been made. In order to do the work that the meter does, it would be necessary to make inspections every month, at least, and in the case of an ordinary residence, it takes about four times as long to make an efficient inspection as it does to read a meter. In apartment buildings an inspection is a thankless job because all the occupants are seldom at home at the same time. The work, therefore, is usually slighted.

It has been found also that efficient fixture inspection is more objectionable to tenants than meter reading because the inspector has to pry into the privacy of the home. The landlords who dislike to pay plumbers' bills for the repair of poor plumbing are the ones who object to meters. In New York it was noted that after six months' work the inspector was stopping leaks at about the same rate as the leakage previously stopped was reappearing.

Unmetered water in completely sewered cities with universal sanitary facilities is usually sold at less than cost per thousand gallons.

In Boston with the gradual introduction of meters up to 60%, the capita consumption dropped from 130 gallons to 90 gallons and in this city vigorous house-to-house inspection was previously practiced. The same may be said of most cities which are metered, although in a few, owing to lowered water rates, with too great a minimum allowance, industrial use, and the other factors which are mentioned above, the curve is more erratic.

Methods of Control

For the past five years the water department of Oak Park has made an intensive study of water consumption with a view of reducing to a minimum the waste, and consequently the quantity of water purchased from Chicago. The city is, and always has been 100% metered, and it has been found that without meters a further material reduction in needless waste would have been an impossibility. In 1913, according to the accepted standards, the Oak Park per capita consumption of 75 gallons was very low, indeed. The night rate of consumption for the total system, however, was 58% of the average daily consumption, while 20% seemed to be a fair ratio for a city composed principally of high-class residences with few industries.

As a result of the waste campaign the daily per capita consumption of Oak Park has decreased from 75 gallons in 1913 to 65 gallons in 1918. Yet who can say that Oak Park is not one of the most sanitary cities in the state of Illinois, if not in the whole country?

There are no privies in this city, every house being connected with the sewers. All the consumers have the benefit of water-closets, 95% have bath tubs; and the bathroom consumed about three-fifths of the water used for domestic purposes. Moreover, every building has a lawn, every street has a grassed parkway on each side of the roadway. From inspection of records of sanitary surveys in various cities with lower and even greater per capita consumption than Oak Park, it was found that the number of premises not connected with the sewers varied between 20% and 80% of the total. Every home in Oak Park is connected with the water supply and there are no active wells except two deep wells used by a gas company as a supplement to the city water, and consuming one gallon per capita. In other cities of which we have record, the wells number 5% to 81% of the total number of buildings.

From the foregoing it follows that Oak Park should use more water than the average city, regardless of relatively small industrial use, because in many cities with industrial plants the big users have access to river, lake or well supply and use the city water only for emergency use or for drinking water.

The Waste Problem

It will be noted that the night rate of pumpage will often be from 80 to 90% of the average daily consumption. This is indicative of much waste. Too much consumption is generally assumed for industrial and other night uses. Such should be determined, not estimated. In Oak Park the night rate, which is considered the waste barometer, was reduced from 56% to 21% of the average daily consumption in the four years between 1914 and 1918, inclusive.

The waste problem was attacked along various lines, some of which are not commonly associated with water consumption. The elements substantially affecting waste elimination as developed in the four years between 1914 and 1918, being these:—

1st. 100% meterage.
2nd. Efficient maintenance of meters.
3rd. Efficient complaint bureau, including education of consumers in cause and remedy of needless waste.
4th. Strict collection of high bills due to leakage or waste.
5th. Periodical waste surveys.
6th. Comprehensive and workable water ordinance, or rules and regulations, with their strict observance.
7th. Centralized control of the water department.

Meterage

With regard to the first item, 100% meterage, this means that all water pumped or otherwise delivered into the system is measured at the distributing point no matter where located. Included among the services metered are all municipal buildings, watering troughs, drinking fountains, street sprinkling, water used in parks, water used in the construction of houses and all dwellings regardless of size or character; together with fire hydrants when used for other than fire purposes. It is admitted that in the construction of buildings and in the case of fire hydrants that sometimes more water is wasted than is measured, but it was found that the moral effect of the meter had a great weight in minimizing the unlawful use of water. It is, in fact, a visible permit. Selective metering has been proposed and widely adopted in many large cities in order to reduce expense, but under that basis it would be necessary to meter only 10% of the Oak Park services, for Oak Park would be considered one of the good controllable districts adapted to periodical inspection, in a city like Chicago, for instance. Under this method, too, the wastage must have taken place before the necessity for stopping it will have become apparent.

Maintenance of Meters

The second item, the efficient maintenance of meters, is more important than appears at first glance. Meters should be repaired as soon as possible after being reported stopped or otherwise defective. This condition of the meter is usually detected by the readings, supplemented by observations of the meter reader. All suspicious variations in the readings, both high and low, should be investigated promptly. It has been found that frequent readings taken not less than four times a year, preferably more, gives satisfaction to the consumer in measuring accurately all the water that is used and in giving ample warning of unavoidable excess consumption. The periodical testing of meters, such as once every five years, has disclosed many unsuspected defects caused by undue wearing of parts, or the detection of tampering by the consumer. In Oak Park

the test of meters which were used by the private company preceding municipal management disclosed under-registration varying between 10% and 50%, with an average of 20% for the entire system. It was also found that in several cases where the bills were not high in spite of very small leakage that the meters did not register leakage as small as 30 gallons per day.

Complaint Bureau

The efficient complaint bureau, and the education of the water consumers, are important both for the satisfaction of the water-taker who tends to regard the meter with suspicion and for the peace of mind of the water department executive who realizes that it does not pay to antagonize citizens. The systematic handling of complaints is infinitely more satisfactory than adverse arbitrary decisions, or spineless methods of leniency caused by fear of political pressure or favoritism. Every high bill can and ought to be explained. The problem is really one of education. In Oak Park the campaign was begun by utilizing the backs of the water bills for admonitions to the consumer referring to the waste of water. This was supplemented by letters to each complainant with follow-ups in order to test the reduction in consumption after the repair of leaks. The meter readers report all suspicious sounds of running water, although not attempting to trace the cause to save time, and the rest is handled in the office by the complaint clerk. If the consumption is abnormal, a special call is made by a complaint inspector before the waste is brought to the attention of the consumer. It was noted that if notices were sent to the consumer before the investigation, he often repaired the fault and then insisted there must be a mistake or that the meter was incorrect, because there could be no leaks. Hence the adoption of a policy of locating serious trouble before reporting it.

No one in Oak Park has ever been obliged to stint in the use of water in order to receive reasonable bills. In fact the leaks consumed 3 to 10 times more water than the consumers themselves can actually use for all purposes. Our investigators proved that, in every case of that kind, there were toilets leaking at the rate of ⅛ to ½ gallon per minute. Sometimes the waste was so small that the watching of the meter did not readily indicate the quantity. Sound is really the best indicator of leaks. This is explained to the consumer who thereafter manages to use all the water he needs, although keeping down the bills. Often a warm meter advocate is thus obtained. It is always a good policy to give the consumer the benefit of the doubt and let it be known that the department is glad to correct errors. In many cases diplomatic cross examinations will uncover sources of waste which the consumers do not realize. It is dangerous to try to prove that the complainant is wrong until you can show him where. Rectify errors promptly. Service is the important element in popularizing the use of meters.

Aside from the waste through fixtures, high bills are caused by leaks in toilets, broken underground pipes in basements, defective toilet valves or ball-cocks, dripping faucets, thermostats, water motors, pumps operated by water power, defective stop-and-waste cocks, leaking valves, breaks in pipes under cement floors and between walls, water used for cooling food, water wasted to obtain a cool drink or to procure hot water from defective heaters, children leaving faucets open, lawn sprinkling with hose without nozzles, the flushings of water-closets uselessly after use for purposes for which they are not designed such as garbage receptacle, leakage through tanks in attics and by allowing water to run continuously in order to prevent freezing or into wash tubs or lavatories for washing purposes instead of filling the bowls or tubs before using.

Domestic Waste Detector

For cases where the department was unable to determine the cause of high bills owing to the fact that there was no leaking and that the consumer was sure he was not wasting water, a recording detector was designed, which when substituted for the meter gives a graphic record of the consumption for 24 hours or a week. This device consists of a piece of brass pipe ½ in. or ¾ in. in diameter and 7 ins. long, into which are inserted two brass tubes 1/16 in. in diameter, one pointed upstream and the other perpendicular to the axis of the pipe. For convenience these orifices or pitot tubes are soldered into ⅛ in. brass nipples. Two needle valves and strong rubber tubing complete the meter. A special type of recorder with a rapidly revolving chart so that drafts lasting only one-half minute could be detected, was constructed, which indicated at what time and how long faucets were left open for baths, for washing dishes or clothes, or for lawn sprinkling; how often toilets were flushed, together with a record of all leakage of 1½ gallons a minute or more. In fact, it was found easy to determine at what time the consumers arose and retired and whether they got up during the night or not.

First Apparatus Was Limited

The pipe, in reality a brass meter nipple into which are soldered permanently two pitot tubes, is inserted in the house service either in place of the meter or connected in tandem with it. In all, only two tubes were necessary for the range of consumption which exists between a four-room bungalow and 24-apartment building. In the first experiments the pitot tubes were connected to a mercury U-tube, by means of which rates ranging from less than ½ gallon per minute to 30 gallons per minute were measured by using the ½ in. and ¾ in. nipples. A camera provided with a revolving sheet of bromide paper, 3 ins. wide, was designed and adjusted so that the lens magnified the deflections through a slot about eight-thousandths of an inch wide. A pocket flashlight supplied the illumination, through a condenser, and the power was furnished by a single-cell storage battery constructed for the purpose. The only drawback to the device was that the high deflections were beyond the range of the slot, although small leakage was detected which the disc meter failed to record.

Will Detect All Flows

The next step, after fruitless attempts to alter the quantitative measuring device of the displacement so that it would register in gallons per minute, was to design a recorder which could take care of all flows. This new recorder will detect rates as low as 1½ gallons per minute, and there is no limit to the maximum recording capacity if larger meter tubes with lower centre velocities are used. The diaphragm is constructed of ⅛ in. mechanical rubber, and it is surprising to note the power transmitted through the stuffing box. The recovery after a short draft is rapid, even at maximum velocities. The recorder is not extremely accurate but frequent rating by means of the regular meter-testing outfit indicates that it is amply dependable. It has been used successfully in connection with a 2-in. Venturi meter, in making waste surveys by means of the hydrant and hose method, and gives much assistance in determining the varying consumption in the district tested, so that the leakage can be ascertained.

Plumbers invariably mislead the consumer by failing to appreciate small leaks and by discrediting the meter. But Oak Park water-takers are rapidly becoming educated in spite of this. After being shown repeatedly the waste which plumbers failed to locate, and seeing the effect of the stoppage of leaks which, according to the plumbers, could not amount to more than 10 gallons a month—they refuse to be sidetracked.

High Bills Caused by Leakage

Regarding rebates on high bills which were caused by leakage, we find that to reduce these indiscriminately is to defeat the purpose of the meters. As stated before, reliance should be placed upon educating the consumer rather than in the practice of allowing reductions in order to avoid adverse criticism or to satisfy some influential citizen. Water-takers easily fall into the habit of depending upon leniency if such is known to be a possible way out of their difficulties. The average consumer can bring the plea of first offense and a promise to be careful in the future. The way it works out though is this: If a rebate is allowed in one case, the tendency of the authorities will be known throughout the community in a short time, and it will be

very difficult to enforce payment of other similar bills. If a complainant feels that the water department is lax, he will not exert himself to keep his fixtures in repair. If, on the other hand, the water officials are known to be severe and exacting, and absolutely impartial, the majority of the consumers will be satisfied that there is an advantage in being on the alert. The minority, it is true, will complain and accuse the manager or other executive of unfairness, but the fact that everyone has been treated alike and that there are no favorites will permit a very successful operation of the "no reduction on account of leakage" policy. Oak Park speaks from experience. Better to allow a lower rate on the water, approaching the cost per thousand gallons in the case of unavoidable leakage; or else adopt a partial-payment plan or both. But charge for every gallon wasted. The lesson will strike home and be appreciated throughout the community.

Waste Surveys in Oak Park

In making waste surveys the most convenient method is to make, first, a rough survey of the entire city by means of the Pitometer. This is done by isolating certain districts by closing gate valves and measuring the supply through one of the mains left open to serve as a feeder. It is possible on small systems to make the preliminary test by shutting down those districts entirely for a few minutes, especially in the residential sections, and note the drop in the rate of consumption as indicated by the recording chart at the pumping station or reservoir or wherever the master meter may be located, providing it is on the distributing system.

It is often found, however, in districts which are completely metered that the velocity of the smallest feed main is so low that it is impossible to obtain an accurate record of the consumption if there are no large leaks. It is then necessary to by-pass the flow of water through a small pipe, 2 ins. or smaller in diameter, in order to increase the velocity. This is commonly called the hydrant-and-hose method because the most practical way of doing it is to feed from a fire hydrant, without the district, through a fire hose to a hydrant within the district. Oftentimes a regular displacement meter is used and the rate is obtained by noting the readings of the meter at regular intervals. This method is not a very useful one owing to the fact that several drafts may occur during the test. In Oak Park two other methods have been used: One consisting of a 2-in. Venturi meter with a ¾-in. throat which can accurately record rates from 3 gallons to 50 gallons a minute. The other is by means of Pitometers inserted into short pieces of pipe 2 ins. or smaller. Thus a quantity as low as ¼ of a gallon per minute can be measured.

Tests Made During Day

Contrary to the usual method of making waste surveys, all tests are made during the daytime, after determining the best hours in which the flow is somewhat steady, for inspection of the Venturi meter at the pumping station. The districts tested varied between ¼ of a mile and 2 miles in length. By being able to watch the rate of consumption, it is rarely found necessary to be on the job for more than half an hour at a time in order to determine the minimum rate of consumption.

The exact population of the district tested is obtained as well as the average daily consumption through the domestic meters—the former from the prevailing school census and the latter from the water accounts. Thus an estimate of the legitimate rate exclusive of the underground leakage is determined. In all cases where there is not much leakage the normal pressure is maintained through 600 ft. of fire hose. In order to bring the reading within the limits of the manometer where the flow is abnormal the valve on the meter is throttled. In one case a rate of 60,000 gallons per day at 10 pounds' pressure in a stretch of pipe only one-half mile long was observed, the normal pressure in the mains being 45 pounds per sq. in. Subsequent investigation by means of the aquaphone disclosed six service leaks which wasted water into the sewer at the rate of 200,000 gallons a day. This meant a leakage per capita rate of 305 gallons per day, while the service meters indicated only a total per capita consumption of 45 gallons, but after the repairs were made the leakage rate per capita dropped to 10 gallons a day.

Water Ordinance

In order to be able to operate the water department efficiently it is necessary that a comprehensive and workable water ordinance be adopted and followed to the letter. All the employees and officials should be able to follow a definite, unswerving policy with a minimum number of loopholes to be detected by skilfull lawyers. The water ordinance is either legal or it isn't. If there be a number of rules which have become a dead letter or are so ambiguous that the executive does not attempt to enforce them because he feels that they would not hold in case of a lawsuit, they had better be tried out immediately or else repealed. The efficiency of a water department is greatly impaired if there is a conflict with other city laws, as in the case of many municipal plants.

Centralized Management

Just a word on the final factor in the control of the water system. It follows from the foregoing paragraphs that all the divisions connected with the operation of large water departments must be under centralized management. It would be better if many municipal plants were made an independent branch of the municipal government. There would then be fewer failures in the operation of municipally owned utilities; failures which are concealed by taxes. There is a little incentive for efficiency in operation if the superintendent or manager makes a decision and is obliged to back down because the complainant is able to obtain a concession from another city official higher up, who is not vitally interested in the operation of the department. It is discouraging if the manager has outlined policies which resulted in a saving to the department and finds that the gains made are taken advantage of by some other municipal division which is not operated efficiently; or used because other funds have been exhausted. It is impossible to prevent needless waste of water against the advice of the manager, or if the manager is continually compelled to yield to pressure from some political adherent of the city fathers.

In the case of complaints on account of high bills, it is disconcerting to attempt adjustments and give satisfaction if the money is collected in one department, "shut-offs" for non-payment of bills handled in another and the meters read and accounts rendered in either of the foregoing or yet in a third one, all these different divisions being independent and under different executives. Unless all policies originate in the same department, there will be neither co-operation nor co-ordination.

The Canadian National Exhibition will open its gates August 23rd, but the formal opening will not take place until Monday, when H.R.H. the Prince of Wales will preside over the inaugural ceremonies.

The Jos. Dixon Crucible Co., of Jersey City, N.J., announces that for the past two years it has invested in Canadian government, provincial and municipal bonds all of its cash returns from sales of its products in Canada. This is an example which, if followed by all of the other American firms doing business in Canada, would be of benefit to Canadian finance. A. R. MacDougall & Co., Ltd., of Toronto, are the Canadian representatives for the Dixon pencils. The Canadian Asbestos Co., Montreal, are the representatives for the Dixon paints and lubricants.

The enforcement of regulations governing the practice of surveying and civil engineering in Idaho now comes under the Commissioner of Law Enforcement, R. O. Jones, Boise, Idaho. There is now a law regulating the practice of civil engineering in Idaho which appears to include all branches except mining and metallurgy. Examination for civil engineers will be held the second Tuesday in September; for surveyors, the first Tuesday in September. No survey of land or plat of same has been legal since June 1st, 1903, unless made by a licensed surveyor.

THE RELATION OF THE ENGINEERING PROFESSION TO ENGINEERING EDUCATION*

By Frederic Bass
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ENGINEERING education must meet the demands of the engineering profession, not only those demands which have been given definite form, but also those which now inarticulate, are struggling for expression. Professions come into being in response to great human needs; and are endowed with vitality and life in proportion as they minister to those needs. The engineering profession is youthful, it has lavished the service of its constructive genius upon a waiting world, and a new order of civilization has evolved with a rapidity unknown in other ages. Men have been given suddenly, within a few score of years, new wealth and power which has brought their minds into contacts a thousandfold multiplied beyond previous experience. In the last four fateful years, new groupings have been formed in unforeseen environments with still further acceleration. The world is now confronted with the problem of quickly adjusting itself to the conditions which are inexorably imposed upon it.

No Clear, Determined Declaration

The question in the minds of men is: Can we meet the situation and master it? The questions in the minds of engineers are: What part is it that the engineering profession must play? Are we going to meet our problems and master them as we have in the past? Are we going to realize this supreme opportunity and marshall our strength to grasp it? If we are, how is it to be done? Were the answers to come from any one of the great number of engineers whose hearts beat for their country and whose minds have grasped its peril, there could be no doubt as to its nature. But how about the answer from the group, from the profession as a whole? What do we hear? One voice loud, emphatic and clear? A babel of sounds from an eager multitude? Or only faint murmurings from the ranks here and there?

We can all agree that no clear, virile, determined declaration has come in unison from the profession, for it is relatively young and does not yet know its place in the world; it has not had the experiences and grapplings with life that alone can teach its true place, its duties, its privileges, its limitations and its power. Time and trial will bring it to a realization of these, a realization that will be splendid and magnificent.

Secondary Positions at Best?

The voices that are heard here and there expressing the hope, and even the confident expectation of the future, are becoming more numerous. They come from the local societies, from the state societies, from the older national societies. As their volume swells, the time for action nears, and in action, clear-headed leadership must be had.

The question might be asked: "What has this history and this concern for the destiny of the profession to do with education?" It has everything to do with it. The students of the engineering schools of to-day will constitute the fibre of the engineering profession of to-morrow. When the choice of a vocation presents itself to a young man, he asks: "Whither does it lead? What tasks await me there? In what company shall I find myself? Am I to be a slave or a servant, or am I to be a master? Am I to be in a position where my constructive genius, whatever it may be, shall lead me to a position where my works shall demand and receive their just recognition, or shall I forever hand the fruits of my labor to others who knowingly or unknowingly shall profligately waste them or throw them aside?"

What is the teacher to answer the boy? Can he point to a life of magnificent service, full of experience, rich with all the associations that the highest type of human being desires, a life in contact with the really great human developments? Or must he answer that engineering organization is weak, that, if he takes up engineering as a life work, he will always be the servant of others, at most, in a secondary position; or, if he finally wins a high place, he will have to fight alone?

The replies to these questionings are to be found in the places where practicing engineers are found, in the character of the profession and its relations with other groups and the general public. As a spring of water rises no higher than its source, so no body of men can rise to greater heights than the individuals which compose it, and if the profession of engineering is to be what its best friends hope it shall be, then it must make such answer to the questionings of youth that shall attract to it the young men of high ideals, of clear mind and vision, of determined purpose; the men who shall be neither servants nor slaves,—but masters of their work. These questionings of youth constitute a direct challenge to each one of this body.

Let the Engineers Lead!

The first requirement in teaching or in any other form of directing men's minds and hands is to give to them a clear, definitive objective, and so it is that the greatest factor in intelligent, fruitful and efficient teaching lies in supplying the motive force a reward for accomplishment. Given that, the problem of teaching is one of direction, and not one in which the teacher must use his energy in forcing unwilling minds to grasp ideas, theories, applications of theories and facts which seem to be devoid of interest. A foreman or superintendent who must continually, with his own hands, do the work of his gang or his force is not the man to produce results. He must keep his attention on all his men and their tasks, encouraging, checking, taking advantage of occurrences and co-ordinating the efforts of all. So must the teacher work, and his students, like the men under the foreman, must receive the inspiration of a clear objective and definite progress toward it, even though the objectives be unlike in character and in degree of remoteness. The engineers of America hold in the hollow of their hands the future of their profession. Let them set the mark, let them demand results from the schools, let them lead and they shall not be disappointed in their followers who themselves, some still better day, shall be the leaders.

New Ideals Affect Curricula

The formulation of ideals and aims and the definition of the fields of activity of the profession would also prove a valuable standard by which engineering curricula might be judged, and according to which all of the separate courses of instruction might be correlated. Such co-ordination both within the schools and without would seem to be a fair primary requirement in education, yet only rarely is such an ideal approached. In many institutions there are inconsistencies in the curriculum, frequent, unnecessary duplications in instruction, omissions of important fundamentals, inclusion of irrelevant subjects, caused on the one hand by slavery to precedent, and on the other by undue susceptibility to fads, both of which exercise influence in the absence of a comprehensive understanding and vital faith in the future of engineering.

This question of curriculum is important; upon it depends to a large extent the equipment with which the student must tackle his job when he graduates. It is fairly uniform throughout the engineering schools of North America, although many variations do exist. All engineering schools require practically the same courses in mathematics, rhetoric or English, mechanics, physics, chemistry, drawing, shop surveying and the various applications of theory to practice, such as machine shop design, steam engines, electrical machinery, structural design, hydraulic and sanitary engineering, railroad engineering and the like. The general assumption among engineering educators is that engineering is almost entirely a technical pursuit, that its foundation lies in an understanding of the forces of nature and their mathematical expression. Observation of engineers' *work* indicates that in the great majority of cases this assumption fits the facts, and that it will continue to do so to some extent, but the conception of the engineering profession which is taking form in the minds of thousands of engineers to-day is a much greater and higher one, and the curriculum must conform to it and will when engineers definitely demand that it be done and see to it that it is done.

*Address to the American Association of Engineers.

It is the engineer's duty in design to plan not only for the present, but for the future; he is coming to see that the structure of his professional organization, while adequate for the past, is being overloaded, and must be reconstructed to take care of future loads; he is about to design a new structure. Engineering college faculties must recognize this and so plan their curricula that the foundations shall include not only the principles of physics and chemistry and methods of mathematics, but those of the basic nature of the human institutions by whose agency and through whose processes the service which the engineer has to offer may be made to bear fruit. The student of engineering must realize this; he must know that his task is to be a more serious one than that which his predecessors faced.

Teachers Should Work "Outside"

The engineers of this country are now beginning to realize their lack of unity. A number of experiences have brought it home. It is perfectly apparent that when a desirable public improvement, either in political method or in application of method to any particular object is to be made, that the advocates of it will have a greater chance of success when their case is well studied and prepared, and when their forces are marshalled so that at the opportune time the final blow can be given with the concentrated power of all. So in the administration and conduct of an educational institution it is important that the members of the faculty agree as to their aim and methods, and can concentrate their force upon their common object. This involves the question of teachers, their organization, and the spirit which drives them on. Some colleges, often for very good reasons, take their own graduates in as instructors, thus losing the advantage of minds with a new viewpoint. Other colleges discourage professional practice among the faculty and thereby tend to divorce the college from the world of action. The most vital requirement of a technical college is that the members of its faculty have at least a sympathetic appreciation of the character of the practising engineers' problems even if it is not possible for them to personally engage in practice themselves. Certain teachers of applied science should be *required* to do some professional engineering work. It is often forgotten that a large percentage of the teachers of engineering students, in language, rhetoric, physics, mathematics and mechanics and drawing, have little or no connection with or knowledge of engineering methods or engineering organization. A still larger percentage are entirely beyond the reach of the renaissance of spirit now manifest among engineers. This problem of keeping the teacher in close connection with the developments of engineering, not only technically, but socially, is fundamental. Every teacher of engineers should be affiliated with at least one national engineering association, the ideals and activities of which are not bounded by too narrow an outlook.

Students Benefited by Discipline

In spite of all that may be done to lead the student to self-help aroused by interest, there must still be some work done because the teacher orders that it shall be done. There must still be some things taken on faith. For this there must be discipline. No system of education can be devised which can rely wholly upon the student's own initiative to maintain order and progress. The statements already made should not be construed to mean that the standard of work, both in quantity and quality should be determined and maintained by the student's interest and not by the teacher; that is the teacher's first duty. A brief period of experience with the Students' Army Training Corps, in which the writer had 900 students in surveying, convinced him of the desirability of a stricter system of discipline among students. The average college student will *not* map out his time so that it may be usefully employed; the army discipline did that for him. He will not generally show the regard for property and persons that is required of students at West Point. There was a noticeable improvement in this respect during and immediately after the recent military training period. While the writer is not willing to see military training in such a concentrated dose again administered to the colleges, he does heartily believe that the average college student would be immensely benefited personally by a strict discipline, not only while under it in college, but afterward. There would be taught the value of courtesy and perhaps of the deeper meaning of courtesy, which is understanding and tolerance of and respect for other people as well as himself. We all recognize the results of it in the splendid officers of the United States army and the navy.

There has been considerable discussion lately in regard to marking systems. Psychological tests for various reactions have been suggested as a substitute for numerical grading of scholastic work. While the writer has only a reading acquaintance with such tests, he believes that after a teacher has come to know the individuals in his class, he unconsciously treats them according to their mental constitution, and as long as his final grades do not entirely depend upon answers to formal questions, they will represent a fair rating. It is not to be doubted, however, that an analysis of the men in a class according to a correct psychological score card, would assist any teacher in a mere accurate estimate of each student's personality and the rate at which he is developing his powers.

A Threatening Development

To summarize here the points which have been mentioned: First, the engineering student must have an ideal which offers an opportunity of realization and which is worthy of the effort of the highest type of man; this ideal must be set for him by the engineers in practice. Second, the engineering curriculum must provide the student with a thorough grounding both in the fundamental principles of natural law and of human institutions. Third, the school must have a faculty in sympathy with the great body of practising engineers, organized themselves with a common purpose to develop every student so far as possible, and to make of him a master of what little he can compass in his college course. Fourth, a certain discipline which shall demand a high standard of personal conduct. With a high ideal, an adequate curriculum, a well organized faculty in touch with the profession and sufficient discipline, the school can perform its duties.

There is one development which threatens the engineering school. Colleges of arts and sciences and of commerce are beginning to recognize the need of the business man and the man of general education for a more definite purpose in his courses of study, a need for those departments of knowledge of which the world is going to demand much; among these, the fundamentals of engineering. If engineering colleges do *not* meet the demand for a broader fundamental training, we may expect to see men choose the courses in the colleges of arts and sciences in which engineering principles are taught, and the engineering colleges continue to hold only the men who wish to confine their interest to strict technical details. If such a development attains any considerable volume and momentum, there will be many college graduates wth insufficient engineering training, attempting to enter engineering practice, men whose teachers have still less sympathy with and knowledge of conditions of practice than those of engineering colleges, and who can be reached and influenced by engineering organizations only witb the greatest difficulty.

Committee on Engineering Education

The whole future of engineering education lies with the profession. When engineers have formed an inclusive national organization that can speak as the voice and authority of a great profession, whose mission is to create and conserve wealth and to demand a higher type of human accomplishment and civilization, the public will listen; financiers, farmers, skilled and unskilled labor will give ear, and order and justice will more and more prevail in the affairs of men. Engineers must first set their own house in order. Only by intense and prolonged study and planning can they do that first task and only by ceaseless vigilance can they maintain it. The labor involved is great and must be divided; it must be done by well chosen committees fully cognizant of the portent of their work. Among these the writer would wish to see a committee on engineering education, well provided with funds to diligently prosecute its labors.

The Carnegie Foundation for the Advancement of Teaching has enabled a notable investigation and report to be made upon the subject of engineering education. This report, admirable as it is, is but a beginning. Such investigation and inquiry should be continuous and more general. The advancement of teaching of engineers means the introduction into the engineering profession of a higher type of man, and this strengthening of the engineering profession means an indefinitely better service to all men.

On the other hand, this same agency has devoted enormously greater funds and efforts to pensioning aged professors. Pensioning means decreased salaries. It is merely a system of enforced saving. It is in this case gratuitous and insiduously undermines independence and self-respect, and is hence essentially a hindrance to the advancement of science. If an agency instituted for promoting education can be found to donate millions for a mistaken method, can one not be found to promote a true method, to promote an inquiry into the problem of attracting to engineering the most promising youths, who shall devote themselves to all the finest and greatest things that engineering includes?

DETECTION OF WATER WASTE*

By L. G. Denis
Hydro-Electric Engineer, Commission of Conservation

THE absolute necessity and great value of taking means to detect and control water waste in a water supply system are being more and more clearly demonstrated. The special means now available for this purpose, when applied to a system operated as was customary in the past, invariably reveal and locate numerous wastages and losses, allowing these to be easily checked and curtailed.

A striking example of what conditions may exist in other systems is given by a municipality of some 30,000 population in the state of Ohio. A recent survey by professional water savers resulted in the curtailment of the total water pumped by more than one-half. This may at first seem an exaggerated statement but an analysis of the various losses revealed and stopped shows that it is quite within reason.

As is usually the case, the losses were principally due to leakage and illegal consumption. The illegal use detected was very large and practically confined to one consumer, a bottle works, the water being taken through a covered connection to the fire line for the property. The company disclaimed any knowledge of the connection although it was being used by them regularly for cooling purposes.

The following shows how the daily consumption was reduced:—

Consumption before survey	3,932,000 gals.
Consumption after survey	1,845,000 gals.
Decrease	2,087,000 gals.

The decrease was made up as follows:—

Leakage detected and stopped	692,000 gals.
Illegal use stopped	895,000 gals.
Unaccounted for	500,000 gals.

The "unaccounted for" decrease of 500,000 gallons was attributed by the experts to the voluntary action of an illegal user who feared detection. That is, it was assumed that another large consumer became aware of the investigations and discontinued the illegal use of water before detection.

The costs in connection with the above-mentioned survey are also interesting to note. The contract price for the entire work by the experts was $2,600, while the extra expense incurred by the municipality in connection with the survey is estimated at $2,600 more. On the other hand, the company caught using water illegally offered to settle for $6,700 in payment of the water used, but the municipality is suing them for $49,000.

*From "Conservation."

REGIONAL PLANNING OF THE NIAGARA DISTRICT*

By Thomas Adams
Town Planning Adviser to the Housing Committee of the Dominion Cabinet, Ottawa

IN order to plan our cities and towns properly we must investigate and analyze many problems which have a bearing on life and growth within and surrounding them. What is true of the individual is still more true of the city. It cannot and does not live to itself alone. Recent events throughout the world have shown the extent to which the town and the country are inter-dependent. Recent tendencies in industrial decentralization have also shown the importance of one of the modern aspects of town planning, namely, the direction and control of the growth taking place within the rural and semi-rural districts where new industries are being established. The artificial boundaries of cities are becoming more and more meaningless. The real controlling factors which determine and encourage industrial growth are physical and natural to a greater extent than they are administrative and artificial.

Regional Survey and Plan

One of the difficulties in dealing with this subject is that we have not yet adopted a clear and unambiguous terminology. The same words have different meanings to many of us. I must, therefore, begin by explaining what I mean by regional planning and regional survey, and I will take them in the logical order:—

1. The regional survey bas to do with the investigation and mapping of the existing physical, industrial and residential features of a region that has interests and problems in common, which needs comprehensive and co-ordinated treatment without regard to arbitrary administrative boundaries.

2. The regional plan is concerned with the general planning of the area included in a regional survey. It is a skeleton and tentative plan of a region within which there is comprised a series of municipal units, in juxtaposition to one another, and having overlapping and inter-related problems. The width, direction and classification of our main and secondary highways should be governed by the needs of such a region and not by the needs of one municipality within it. This principle is fully recognized in Ontario highway legislation, in regard to the principle on which the cost of construction is apportioned. The planning of our system of communications in the regional plan should also have regard to the classification of land for different purposes of industry or residence. Land should be classified in a general way for industries, for residences, and perhaps for agriculture, for park areas or for special reserves or as unsuitable for building purposes. We would also consider within the region how far it is desirable to prescribe a code of housing and town planning regulations to deal with building conditions that need to be dealt with in common over large areas of different character. Sewerage and water supply may have to be dealt with in large regions to obtain efficient and economical schemes in cases where it is not practical to get an efficient system of either in separate units of administration. These and other problems that can be dealt with in a preliminary and general way need regional rather than municipal treatment.

The Town Plan

3. The town plan is the definite plan, accompanying a definite piece of legislation, for fixing within the city or the county areas first those parts of a regional plan which are locally approved, and secondly, the civic design and regulations dealing more intimately and precisely with the problems connected with the growth of the town, its means of communication, its industrial development, its residential areas, its character and density of building, etc.

We thus have three distinct processes, each connected with one another, and logically leading up to one another, which are the regional survey, the regional plan and the

*Address at the National City Planning Conference, Niagara Falls, N.Y.

civic plan. It is unnecessary for me to argue with town planners how hopeless the task is to attempt to prepare a plan without having obtained accurate data regarding existing physical and industrial conditions.

The Niagara District's Problems

The Niagara district seems to me to be one which needs the making of a regional survey and a regional plan as a preliminary to a series of civic plans for its city, town and county areas. Neither Buffalo, nor the Tonawandas, nor Niagara Falls, are strategic centres; they are parts of a strategic centre of 1,000 square miles in extent on both sides of the Niagara River. The problems of this region are international, and give us proof that the power of natural conditions is so great that even the boundaries of nations do not form intelligent and appropriate boundaries to regional and town planning schemes. Indeed, may we not hope, that in the process of planning them we shall help to knit these two nations, their industries and people, closer together; and also that the bridge which we propose to erect as a symbol of peace will be more than that—will be a symbol of co-operation and mutual respect? Personally, I should like to see something more than a physical bond, such a bond as could be provided by a Regional Planning Commission representative of the State of New York and the Province of Ontario to deal with the planning problems of the Niagara district. That need not be an idle dream any more than the creation of an International Waterways Commission.

Superficial study of the problems which need to be dealt with within the Niagara region has convinced me that the whole district, for at least 20 miles on either side of the Niagara River, needed to be made the subject of a regional survey. The Niagara district is one with enormous potentialities for future commercial development. It has a strategic position of great importance to both our countries, and it has certain advantages as a tourist centre which are sufficiently in conflict with the aims of those who are interested in its industrial expansion to make it important that a survey be made before any definite plans are adopted by any municipality within the district.

Area and Population

What I call the Niagara District comprises approximately 20 miles on either side of the Niagara River for a length of 28 miles between Lakes Erie and Ontario. Further west in Canadian territory another regional area has the city of Hamilton for its centre. In the United States the area covers all the county of Niagara with the exception of the towns of Somerset, Hartland and Royalton, and in county of Erie includes the towns of Tonawanda, Amherst, Clarence, Cheektowaga, Lancaster, West Seneca and Grand Island. The total area is over 700,000 acres, of which about 317,000 acres are in Canada and 418,000 acres are in the United States. The present population is estimated at about 751,600, made up of 86,700 on the Canadian side and 604,900 in the United States. Buffalo is not the geographical centre of the region, although it is the predominant partner among the local units by reason of its size. Further consideration might lead me to include more of the southern environs of Buffalo to a distance of 10 miles from its centre.

Including all towns of less than 7,000 population, the rural population on either side of the border is about directly proportionate to the rural area, being about one person for a little less than seven acres on the Canadian side, and one person for a little over six acres in the United States. The densities of Lockport and the Tonawandas are very low, being only about 4.5 persons and 2.7 persons respectively per acre. An estimate of the population gives 1,170,000 for the Niagara frontier regional area in 1950. It has been considered that the rural population would remain unchanged, and the estimate has been based on future growth curves of the combined total of three Canadian cities in the region and six of the regional cities in the United States.

Consolidation Desirable

A study of conditions shows that cities are growing along the Niagara frontier and the Welland Canal, so that their boundaries are being forced out to meet the smaller towns. For example, Lasalle is now really a residential part of Niagara Falls, N.Y., but Niagara Falls has no control over its development, although the boundaries of these two places are now adjacent. Consolidation is considered desirable in these places as well as in St. Catharines, Merriton and Thorold; Lancaster and Depew, partly industrial and partly residential, have similar problems; Bridgeburg and Fort Erie, Port Colborne and Humberstone are other cases in point. Then there is the larger question of what areas will soon be incorporated in the city of Buffalo. Evidently there is great need for some definite control over suburban areas, or looking further into the future, areas that are to become suburban areas, and eventually urban areas.

Purposes and Problems

For what purposes do we require more accurate information, and what are the usual problems that have to be dealt with in planning a large region? We may summarize these purposes and problems as follows:—

1. Industrial development—including the arrangement and classification of all lands and the location and distribution of manufacturing plants.
2. Economic use and regulation of the sub-division of land and the character and density of structures in rural and urban areas.
3. Housing—sanitation, convenience and amenity.
4. Transportation—railways, highways and waterways.
5. Sources and distribution of power.
6. Water supplies and sewerage.
7. General amenities—including parks and boulevards and development of tourist facilities.

I will now proceed to consider some of those principles in relation to the problems of the Niagara district.

Industrial Development

In the Niagara district the varied character of the soil and its great fertility in the rich valleys, make it of special importance that the system of distribution should be of the best kind to encourage the maximum of agricultural production. Being an old settled region it is probably impracticable to carry out any schemes of re-planning or re-classification of the lands. It is in connection with the growth of manufacturing industries that the chief problems occur. The combination of cheap power, adequate transportation facilities, and reasonably priced land are having their effect in promoting rapid manufacturing development in the region. As an example the town of Welland had only five factories five years ago and now has thirty. In the cities and towns on the Canadian side there are 145 manufacturing establishments; and on the United States side, 183 outside of Buffalo. The manufacture of cereal foods and the canning and preservation of fruits and vegetables are carried on side by side with the manufacture of aluminum, calcium carbide, etc. Too little regard has been paid even in recent years to regulating the location of objectionable industries, and great and perhaps unnecessary injury has been caused to the great asset of scenic beauty possessed by Niagara Falls. The need for zoning is evident to the casual observer; the methods of carrying it out require prolonged study so as to avoid injury to industrial development.

The low-lying land to the north of the escarpment and also including the area for a few miles south of the escarpment on the higher land is excellent soil and well suited for fruit farming. The balance of the region is only at Lake Erie level, and presents some drainage problems, especially in the clay strip that runs through the centre of the region. On the Canadian side, near Lake Erie, shallow soil is also encountered, with limestone outcropping near the surface, and peat bogs are also encountered. Generally speaking, the level area which is given up to dairying and general farming, has not been developed up to the possibilities of the soil.

Housing Situation

Generally speaking, no protection is afforded to residential areas in the region, and sanitary conditions are defective in districts occupied by workingmen's families. There is an estimated shortage in the cities, not including Buffalo,

in the region of about 2,350 houses. Taking the figure of 2,350 as the shortage in houses and an estimated population of 168,000 it will be found that for every seventy people there is another house needed.

A survey of housing conditions is needed not only to ascertain facts with regard to the shortage, but also to find out the best means of raising the standards of existing dwellings and improving sanitary conditions.

Railway Situation

The numerous railways that serve this area make it a great railway centre, and perhaps unrivalled for rail transportation faciilties. At Gardenville gravity freight yards, near Depew, some $25,000,000 is to be spent, and the yards completed in the next ten years; $6,000,000 has already been appropriated.

At the Lake Erie end of the region there is only one railway bridge, and that single tracked. Trains are said to cross at the rate of one about every seven minutes, and there are 15,000 cars of merchandise passing through every month. The C.P.R. may consider it desirable to build bridges at Goat Island to cross the Niagara River and give them their own bridge entrance into Buffalo.

As far as the cities and towns are concerned, the greatest problem is that of grade separation. In this matter the railways have had the upper hand in the past, and it is time that the general interests of the public were safe-guarded in connection with railway enterprises to a greater extent than hitherto. But it is not the railway corporations that are to blame; the fault lies with the local authorities in not taking action in time. Portions of Niagara Falls, Ontario, and Niagara Falls, New York, are practically devoted to switching, and this right on some of the busy streets. For example, in Niagara Falls, Ontario, there are 14 level crossings. It would be an advantage to have the tracks of the electric radial railways moved from the central streets of cities and towns in certain cases. In other cases, streets are too narrow for double tracking.

Highways and Waterways

Even a preliminary survey of conditions on the Canadian side, across from Buffalo, would seem to indicate that that area is being hampered in its development by the lack of a highway bridge. A "peace bridge" has been proposed as a memorial, and it is stated that bills are now before the governor of the State of New York, one for a bridge at Buffalo, and one for a bridge at Niagara Falls. Apart from the question of the peace bridge, there is no doubt as to the need for a bridge at Buffalo across the Niagara River, but the means of communication on both sides of the river need to be studied before the site of the bridge is settled.

The Niagara River, as a waterway between Lakes Erie and Ontario is, of course, impossible for navigation. On the Canadian side the Welland Canal provides a waterway between the lakes.

The great improvement which is taking place in regard to the waterways which feed the district will be certain to greatly increase the population and industries of the region in the near future, and they will also tend to create changes in regard to local conditions of development and settlement of land. A regional survey and plan is needed to deal with expected growth and change of conditions, even if no other development of transportation facilities were taking place. It is also important, as we shall see later, to consider the park system of the region, and perhaps the drainage system also, in connection with the abandonment of old waterways.

Power Situation

The rapidity with which the demand for electrical energy has grown is indicated by the fact that the first modern power development at Niagara Falls took place in 1890, with an initial installation providing for the production of 100,000 h.p. At the present time the total production is 650,000 h.p. At Power Glen, adjacent to St. Catharines, there is also a development of some 52,000 h.p. There is also under construction a plant to produce an additional 400,000 h.p. The principal development is that of the Hydro-Electric Power Commission of Ontario, which is constructing a canal 8½ miles long to divert the flow of 10,000 second ft. of water and provide for the ultimate development of 300,000 h.p. at Queenston. This enterprise will cost $25,000,000, and will not be completed until 1921.

There has been some criticism of the construction of the open cut, which is having an injurious effect on adjacent property, and will make the city of Niagara Falls, Ont., an island. Whether this criticism is justified or not, and whether part of the canal should have been in tunnel, as apparently would have been practical, does not concern us, but the fact that it is made shows that no such scheme should be carried out without careful study of all the factors, including those outside the purview of the hydro-electric engineers, before this kind of enterprise is begun. The day should be past when great corporations, whether railway or power companies, should be permitted to ignore the effects of their enterprise on the industries, property and lives of the community as a whole.

Water Supply and Sewage Disposal

Lake Erie is the source of water supply for the urban population in this region, water being obtained either via the Welland Canal or the Niagara River. There is pollution of the Niagara River, practically none of the cities or towns treating their sewage. This pollution will be increased, with the completion of the Welland Ship Canal and the entrance of the water from the Welland River into the system. It has been decided to have a pipe line extending from Lake Erie to Lake Ontario to supply the cities and towns along the canal.

The Tonawanda Chamber of Commerce is considering a scheme of sewage disposal for their whole area. F. W. Barrally, city engineer for Tonawanda, has done some preliminary work on this scheme which, it is claimed, provides for sewage disposal and drainage of the outlying area along the Niagara River, and incidentally for the development of power. It would avoid the very serious pollution of the Niagara River, and would use the old Erie Canal as a drainage canal for sewage from Buffalo to Tonawanda. There is urgent need for study of the sewage disposal problem of the whole district so as to get an economical and efficient system.

Parks and Tourists

Both the rural and urban areas seem to be deficient in parks. It might almost be stated that the cities and towns have no parks. An estimate had been made that from 1885 to 1907, 15,000,000 visitors have viewed Niagara Falls. In spite of all that has been done, it cannot be said that sufficient care and vigilance has been taken to preserve the remarkable scenic beauties of this region, or to regulate industrial development so as to prevent injury to the amenities of the district, with loss of convenience or efficiency. The commercial value alone of the great combination of natural and historic features is such as to justify the expenditure of more money and effort in conserving them. At old Niagara, with its large "Commons," there are points of historic interest, and the ruins at Fort Erie at the southerly end of a possible park system should also be preserved.

But it is a regional and not a local problem. The district has been endowed by nature with exceptional gifts, extensively as well as intensively. People should be attracted here to spend days instead of hours. All these matters I have referred to, create one big problem that requires big men to solve it and raise it above the level of the politics of the village pump. The whole question of the development of this region in all of its ramifications is big enough to be dealt with internationally. As an immediate practical measure I suggest that a permanent conference or a joint town planning commission of representatives of all the municipalities in the region, be created to prepare a regional survey and a general plan for the area; that federal, state and provincial aid be invited towards the preparation and carrying out of a comprehensive scheme. This need not be done in any way that is unconstitutional, or so as to interfere with local autonomy. It need not involve that any municipality now engaged in preparing its own scheme suspend its operations, but merely that it recognizes that it is only part of a greater whole, and that whatever it does should be made to fit a regional plan.

COST AND SERVICE OF NEW YORK STATE HIGHWAYS*

By George C. Diehl
County Engineer of Erie County, New York

ESSENTIAL elements in the costs of highway transportation are the cost of road construction and maintenance, and the cost of vehicle construction, maintenance and operation.

The first two costs are primarily the concern of the highway engineer. In these days of million and billion dollar expenditures, there is a tendency to expend fabulous sums for permanent highways, so-called.

Of course, every highway engineer is well aware that no road surface is permanent, and the time is sure to come when a new surface must be constructed.

The actual annual cost of a highway includes the yearly interest and sinking fund charges, the yearly cost of maintenance and the yearly allowance to provide a resurfacing fund.

Interest and sinking fund requirements cease when the honds mature, but this is often from 30 to 50 years, and for that period, at least, should be included; and at maturity it is difficult to foretell road requirements and problems.

Large sums of money have been squandered in the construction of too expensive highways, as well as in the failure to provide sufficient funds.

Accurate Statistics Needed

Sooner or later, every wasted dollar must be made good —generally by the consumer, who staggers under high living costs, and is apprehensive lest there be no check in rapidly mounting prices. The only sure remedy is to practise economy, particularly in the disbursement of public appropriations, knowing that every dollar saved helps lift the burden. Accurate statistics, comparing tonnage, construction, maintenance and financing costs, would help to determine sound highway policies and proper types of construction, including widths, cross-sections and materials.

Unfortunately, such statistics have not been gathered, but a systematic record of costs and travel should be outlined and comparative figures collected which would be of great value in a year or two, and absolutely indispensable after a term of years.

New York State has expended more money than any other commonwealth in highway construction and has the greatest mileage of connected improved roads, so that her experience is of value in considering the highway problem.

There cannot be much doubt that an expenditure of $50,000 to $60,000 a mile is required, and would be justified on the main highway from Buffalo to New York, and possibly on a few other important trunk lines. It is equally certain that expenditures of upwards of $30,000 per mile would be grossly extravagant on a great part of the state and county highway system, and that $15,000 per mile would be far too much to spend on the preponderating majority of lateral roads.

A prominent highway official recently stated that every mile of road in the state should be of a type costing at least $30,000 per mile. There are 80,000 miles, and this plan would require $2,400,000,000—so impossible that discussion is unnecessary.

All Macadam at Start

Starting in 1898 with an appropriation of but $50,000, which was supplemented by an equal amount by the localities, the state engineer improved about 12 miles of highways with water-bound macadam at an average cost of $8,000 per mile. This type of pavement was specified almost exclusively until 1909, and 2,000 miles were constructed during this period at an average cost of about $9,000 per mile.

In 1909, the State Highway Commission was created, and about the same time motor vehicle traffic began to increase very rapidly, and other types, such as the asphalt macadam, both penetration and mixed methods, and brick block, became quite common. In 1915, about 61%, and in 1916, about 46% of the state projects provided for the water-bound macadam type of pavement, and a total of about 3,560 miles of this class of pavement was constructed.

Many of the older water-bound macadam pavements which had been constructed on the main routes have been resurfaced, and in some instances reconstructed with more substantial pavements. By reference to the State Highway Bulletin, just published, it can be noted that about 1,040 miles of these pavements have been resurfaced, about 205 with the same type, 810 miles with asphalt macadam, penetration method, and 25 miles with asphalt macadam, mixed method; and about 125 miles have been reconstructed, 67 miles with new concrete pavement and 58 miles with new brick pavement, leaving about 2,600 miles of water-bound pavement still in the state system.

Resurfacing and Reconstruction

New York State, in building water-bound macadam pavements continuously for 20 years, to the extent of 3,560 miles, has found it necessary to reconstruct with a pavement of a radically different type 3½% of the total, and resurface with a new top course of macadam, using the old pavement as a foundation, about 30%.

During the first ten years of state highway improvement, 1899 to 1908, no maintenance was provided by the state, but the law provided that the maintenance should be performed by the towns. In 1909, state maintenance work and supervision were instituted. The water-bound macadam pavements have accordingly been separated into two groups. Of the 2,000 miles of water-bound macadam constructed from 1899 to 1908, and upon which maintenance had been neglected, about 860 miles, or 42%, have been resurfaced and reconstructed. Of the 1,560 miles constructed between 1908 and 1918, about 180 miles, or 12%, have been resurfaced or reconstructed.

With modern conditions of traffic, where motor vehicles predominate, water-bound macadam can only be maintained by surface treatment of asphalt or tar. With the light, cold materials and heavy traffic, the surface treatments are required every year, while with average traffic the treatment may be omitted about every third year.

When the surface treatment is delayed beyond the proper time, surface holes develop rapidly and constant patching is required.

In 1909, the state first undertook the construction of the asphalt macadam, penetration method, and this pavement soon became the prevailing type for the main through and market routes.

The state system now includes about 3,000 miles of this type, of which about 850 miles are old, water-bound macadam, gravel and second-class concrete pavements which have been resurfaced with a new asphalt macadam top course, laid over the old pavement as a foundation.

Maintenance of Asphaltic Macadam

It is significant to note in the bulletin that of the 3,000 miles that have been so constructed, it has been found necessary to reconstruct but about 10 miles, or ⅓ of 1%, with a pavement of different type. About 8 miles have been reconstructed with concrete pavement and about 2 miles with brick pavement. One hundred and ten miles, or about 3⅔%, have been resurfaced with a new top course of the same type. Many of these pavements have been subjected to nine years of traffic and are in perfect condition to-day, resembling sheet asphalt.

Little maintenance is required for asphalt macadam pavements for the first three or four years after construction.

About four years after improvement the pavements are given a surface treatment of light asphaltic oil, which acts as a flux to the asphalt in the macadam, which works to the surface and is distributed by traffic, to the extent that

*From "Good Roads," New York.

the seal coat is renewed, and under ordinary conditions another treatment will not be required for at least five years after the first treatment.

Little or no trouble is experienced by pitting or raveling, and the pavement will stand considerable neglect without serious deterioration. The cost of maintenance for the first three years of ten asphalt macadam pavements, selected at random, aggregating 54 miles, is found to be $180 per mile per year.

Bituminous Veneer on Concrete

During the period from 1912 to 1914 there were constructed about 300 miles of second-class concrete and Hassam concrete, with a light, bituminous surface, generally of tar.

These types have not given satisfaction, as the concrete does not sustain traffic without disintegration unless protected by a bituminous mat. This light veneer surface of bituminous material is with difficulty maintained, and constant patching of the surface is required. These pavements have been covered with a course of asphalt macadam as fast as funds would permit, and about 40 miles, or 13%, of the total have been so treated, about 24 miles having been surfaced with the penetration type and 16 miles with the mixed method of asphalt macadam. These types were discarded in 1914, when the first concrete pavements of the present-day type were constructed.

There are now 360 miles of standard concrete pavements in the state highway system, all constructed within the past five years.

Commencing in 1909, and continuing to date, the State Highway Department has constructed a limited amount of brick pavement each year. There are now 350 miles of this pavement in the state system.

The state system contains about 122 miles of asphalt macadam (mixed method) pavements of various specifications, laid both on macadam and concrete base, which have been constructed over a period of ten years. Less than ½ mile has been reconstructed or given a general resurfacing.

In order to determine the relative cost of maintaining the various types of pavement, the State Highway Commission in the year 1915, decided to segregate the expenditures for maintenance and repair, charging to the various types of pavements all expenditures obligated to the roads of such types, and in the annual report for the year 1917 is found a tabulated statement of the average cost per mile, combined for the years 1915, 1916 and 1917, for the types having a material mileage in the state system.

Resurfacing Costs Omitted

This table should be qualified by a statement giving the average age of the pavements, as the relative cost of maintenance bears some considerable relation to the average age of the pavements maintained.

The ages of the pavements in the New York system in 1917 ranged about as follows: Water-bound macadam, 1 to 18 years; asphalt macadam, penetration method, 1 to 8 years; concrete pavement, 1 to 4 years; brick pavement, 1 to 8 years.

The maintenance cost data published by the New York Commission does not include resurfacing costs of brick and concrete pavements—as such work—as these pavements are not yet old enough to require resurfacing.

As the old macadam type of pavements shown in the table carries the resulting resurfacing charge, it will be necessary to eliminate this expense or to add an estimated charge for resurfacing of the concrete and brick pavements, and the first method would appear more consistent.

By reference to the annual reports and the latest bulletins, it is determined that during the years 1915-1916-1917, some 635 miles of resurfacing was performed, and that the average cost of the new top course, generally of asphalt macadam, was $6,260 per mile.

Five hundred and five miles, or 21%, of the water-bound macadam was resurfaced, representing an average charge of $437 per mile per year when distributed over the average number of miles of this type maintained; 57 miles, or 2%, of the asphalt macadam, penetration method, was resurfaced in this period of three years, the cost of which, distributed over the entire mileage of the type, represents an annual charge of $45 per mile. The records of the bulletin indicate that of the 80 miles of this type constructed in 1909, only 7.2 miles, or 9%, have been resurfaced in a period of nine years, or 1% per year.

Thirty miles of gravel and 43 miles of second-class concrete were also given a new asphalt macadam top course during this period, but as the types are obsolete they will not be considered in the table of comparative costs.

Complete Data Not Available

In the accompanying table an effort is made to illustrate the economic features pertaining to the selection of a pavement suited to the average highway having average traffic conditions. The cost of improvement is based on estimates prepared and proposals received by the New York State Commission and the fixed charge of interest is computed at 4% (sinking fund charges being omitted).

Type.	Average cost of improvement.	Interest on first cost at 4%.	Average cost of maintenance.	Total cost per mile per year, exclusive of renewal.
Asphalt macadam (penetration method)	$22,000	$ 880	$419	$1,299
Water-bound macadam	20,000	800	539	1,339
Concrete	35,000	1,400	124	1,524
Brick	50,000	2,000	196	2,196

The cost of upkeep and maintenance is taken from the published data in the report of the New York Commission for the year 1917, which has been amended by subtracting the cost of resurfacing of the macadam types as enumerated above in order that a consistent comparison may be made of maintenance costs only.

Complete data are not available with which costs of ultimate renewals by resurfacing can be determined.

While the periods between resurfacing of the more costly types are of longer duration than are those of the macadam types, the cost of such resurfacing is more expensive.

This table appears to demonstrate conclusively that the majority of the mileage should be constructed of the two macadam types.

The New York statistics are not sufficiently complete to determine what is the character and amount of traffic which will require the more expensive types.

Complete statistics should be collected; a traffic census should be taken frequently, and interest, sinking fund, resurfacing, renewal and maintenance cost per ton-mile ascertained, also the annual tonnage per foot width of road metal.

Wider Roads and Control

The demand for wider roads and more rigid control of traffic is even more pressing than of more durable types.

Until more detailed reports and statistics are available it will not be possible to estimate accurately probable traffic increase or to select in doubtful cases the most economical types of highway construction.

It is certain that the most heavily travelled highways should be wider, and that increase of width will add greatly to the life of all types of pavement.

At present 10% of the New York State improved highways are of brick or concrete construction—90% of bituminous and macadam types.

A careful study of New York State statistics and highways would indicate that there should be in the state aid system a gradual increase in the percentage of brick and concrete, with a corresponding decrease in percentage but not in mileage of other types, but it is unlikely that for many years the proportion of the more expensive types should exceed 20%, and at least 80%, or four-fifths, of the mileage will be of the various bituminous macadam types.

EFFECT OF VIBRATION, JIGGING AND PRESSURE ON FRESH CONCRETE*

By Duff A. Abrams
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EXPERIMENTAL study of the effect of vibration and pressure on fresh concrete on its strength and other properties is of interest in view of the frequent use of such devices as hand-hammering of forms, or air-hammering, jigging or vibration as an aid in placing concrete. Such methods are particularly applicable to the construction of reinforced-concrete ships and houses, where thin sections and a multiplicity of reinforcing members are of common occurrence. Jigging or vibrating machines are frequently used in concrete products plants. The effect of pressure on fresh concrete is of interest in certain problems of concrete design.

Little attention has heretofore been given to the experimental study of the effects produced by vibration and jigging fresh concrete. A few tests were made in a study of the effect of pressure on fresh cement paste in a confined space by James E. Howard, at Watertown Arsenal. The effect of pressure on the compressive strength and bond was studied by the writer at the University of Illinois in 1913. Since the tests now reported were completed, Prof. F. P. McKibben has published a report on compression tests of concrete columns which set under pressure.

The tests covered by this report were made as a part of the experimental studies of concrete and concrete materials being carried out through the co-operation of Lewis Institute and the Portland Cement Association, and include the following topics:—

1. Different methods of hand-molding of test cylinders.
   - (*a*) Puddling with ⅝-in. round steel bar (varying number of strokes).
   - (*b*) Tamping (tampers of different size).
   - (*c*) Tapping metal forms after puddling.
2. Effect of vibrating fresh concrete (small electric motor).
   - (*a*) Time of vibration varied up to 1 min.
3. Effect of jigging fresh concrete.
   - (*a*) Concrete of different mixes (1: 7 to 1: 3).
   - (*b*) Concrete of different consistencies (0.70 to 1.25).
   - (*c*) Using aggregate of different grading (fineness modulus 4.00 to 6.50).
   - (*d*) Using aggregate of different sizes (0-28 sand to 0-1½-in. concrete aggregate).
   - (*e*) Using coarse aggregate of different shape (pebbles and crushed stone).
   - (*f*) Effect of rate of jigging (0 to 150 r.p.m.).
   - (*g*) Effect of height of drop (0 to 0.50 in.).
   - (*h*) Effect of length of time jigged (up to 3 mins.).
   - (*i*) Effect of age of concrete before jigging (up to 6 hrs.).
   - (*j*) Jigged with 30-lbs. weight on top of fresh concrete.
   - (*k*) Hand puddling on jigging machine while in operation.
4. Effect of pressure on fresh concrete.
   - (*a*) Using different pressure (0 to 500 lbs. per sq. in.).
   - (*b*) Effect of duration of pressure (15 mins. to 16 hrs.).
   - (*c*) Effect of removal of water by pressure.

This series included 900 compression tests of 6 by 12-in. concrete cylinders at the age of 28 days. All specimens were made from the same materials at the same time, consequently direct comparisons may be made between any two sets of tests.

*Excerpts from paper presented to the American Concrete Institute.

The tests gave conclusive results on many phases of the effect of vibration, jigging and pressure. In some instances the effect is entirely different from what accepted opinion would suggest. Following is a brief summary of the tests:—

Puddling and Tamping

1. Varying the number of strokes from 12 to 50 on each 4-in. layer in the standard method of hand-puddling with a ⅝-in. bar had little influence on the compressive strength of ordinary plastic concrete.

2. In general, the tamping methods used gave lower strengths than hand-puddling.

3. A tamper of large diameter for a given weight was less effective than one of small diameter.

4. Increasing the thickness of the layer from 4 to 6 ins. caused a falling off in strength of about 12% for tamped concrete.

5. Tamping or puddling the first 4-in. layer only caused a falling off in strength of 10 to 13%.

6. Striking the metal form with a steel bar after the completion of moulding by standard method had no effect on the strength of concrete.

7. The "standard" method of hand-puddling, using 25 strokes with a ⅝-in. steel bar for each 4-in. layer of concrete in a 6 by 12-in. cylinder is recommended for laboratory tests of concrete.

Vibration with Electric Hammer

8. Vibration of the specimen after moulding by means of an electric hammer running at 1,000 r.p.m. had little influence on the strength of the puddled concrete up to a period of about 30 seconds. If continued, there was a steady falling off in strength; after 45 to 60 seconds the strength was only 90% of that produced by the standard method of puddling.

9. In general, jigging in any manner with the apparatus used reduced the compressive strength of the concrete, regardless of the height of drop, rate or duration of treatment. Exceptions were found in the dry mixes and those made of aggregates of the smaller sizes.

10. There was little difference in the effect of jigging due to the quantity of cement used.

11. In the very dry mixes the strength, due to jigging for 20 seconds, was increased about 25%.

12. The wetter mixes (relative consistency, 1.10 to 1.25) were reduced in strength 3 to 6% by jigging.

13. Pebbles and crushed limestone as coarse aggregate gave essentially the same results in the jigging tests.

14. The concretes for finer aggregates showed a material increase in strength with jigging in both 1: 5 and 1: 3 mixes.

15. For aggregate coarser than about ⅜ in., jigging reduced the strength from 3 to 10%.

16. The grading of the aggregates (for a given maximum size) had little influence on the effect of jigging.

17. The greater the drop, the greater the reduction in strength for 1: 5 concrete. For a drop of ½ in. the strength was reduced 12%.

18. The faster the rate of jigging, the lower the strength of 1: 5 concrete. Using 1½-in. aggregate at 150 r.p.m., the strength was reduced about 13%.

19. The strength of 1: 5 concrete fell off rapidly with the duration of jigging. After 2 to 3 minutes' jigging the strength was reduced about 20% as compared with standard method of hand-puddling.

20. Allowing the concrete to stand for a period of time before jigging increased the strength to a slight extent. The maximum increase was found at 2 to 4 hrs.

21. The application of a pressure of 1 lb. per sq. in. during the jigging process (equivalent to a head of 1 ft. of fresh concrete) gave the same strength as standard hand-puddling.

22. Moulding the cylinders by the standard method on the jigging table while it was in motion gave the same strength as standard hand-puddling without jigging.

(Concluded on page 194)

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FORESTS OF BRITISH COLUMBIA

At no time in the history of Canada has an accurate knowledge of our natural resources been of more vital importance than at present. In view of the keen commercial competition that will surely accompany "reconstruction," and because of the much larger national debt which Canada must now carry, all the efforts of this country must be devoted to the intelligent utilization and conservation of our natural resources.

To this end, accurate knowledge of the extent and character of our resources is of the greatest possible value. Very timely, therefore, is the splendid report on the forests of British Columbia which has just been published by the Commission of Conservation, Ottawa. This report has been prepared by H. N. Whitford and Roland D. Craig under the direction of Clyde Leavitt, chief forester of the Commission. It comprises 390 pages of type matter and tables, 6¾ by 9¾ ins., in addition to a 19-page index, numerous inserts bearing half-tone illustrations, and several folded maps.

Part 1 covers geographical, physiographic, climatic and soil relations; land tenure; forest administration on provincial and Dominion lands; forest policy and exploitation; trees and insect injuries.

Part 2 describes the forest resources of the interior of British Columbia, of the coastal belt of the province, and of the province as a whole. Appendices are the timber sale contract form, volume tables compiled by the British Columbia Forest Branch, and a condensed British Columbia log scale.

As the authors point out in the introduction to their report, it is poor economy to attempt to develop any industry for which the basic materials are not available in sufficient quantities to ensure successful operation. In order that industry may be intelligently applied, a knowledge of the natural resources upon which it depends is fundamental. Through lack of knowledge, the forest resources of Canada have often been described as "illimitable." While the forest resources of British Columbia are vast, constituting one of Canada's most important resources, they are not illimitable, and the report just issued by the Commission of Conservation will aid greatly in their proper conservation. Incidentally, it may be pointed out that the definition of the word "conservation" that has been accepted by the Commission, includes efficient utilization.

Letter to the Editor

METRIC SYSTEM REVISED

Sir,—Referring to my letter re international measures, published in last week's issue of your paper, would you be kind enough to add the following tables:—

PROPOSED TABLES

Length

1,000 mils = 1 inch (131% present inch).
10 inches = 1 metric foot.
3 metric feet = 1 meter (exact).
100 metric feet = 1 chain.
4,800 metric feet = 1 mile (99.4% present mile).

Area

100 square inches = 1 square foot.
9 square feet = 1 square meter (exact).
36,300 square feet = 1 acre (99.7% present acre).

Content

1 cubic inch = 1 ounce.
100 ounces = 1 gallon (82% Imp. and 102% American gal.).
1,000 ounces = 10 gallons = 1 bushel = 1 cubic foot.
27 cubic feet = 1 cubic meter.

Weight

1 cubic inch = 1 ounce.
12 ounces = 1 lb. (98% present pound).
2,000 lbs. = 1 ton.

C. R. COUTLEE,
Department of Public Works.

Ottawa, Ont., July 28th, 1919.

CONSTRUCTION OF WATER-BOUND MACADAM ROADS

(Continued from page 178)

macadam surfaces are damaged by the melting of the snows. It is impossible to hasten drainage in this territory, where the land has practically no slope.

It has been suggested that in the most exposed places, the surface should be rebuilt with a bituminous binder. Where the water crosses the road with a strong current, a local concrete pavement is usually recommended. There are, however, a number of places where the erosion is purely accidental, and in these places it is sufficient to repair the macadam surface in the ordinary way.

We must carefully distinguish between disintergration of macadam and wear. The wear is natural and unavoidable, otherwise we would have roads with permanent surfaces, which is an impossibility. It is therefore not always wise to undertake repairs at the first sign of wear on macadam. At other times, on the other hand, wear can be retarded and life lengthened by the application of certain materials such as bituminous binders, asphaltic oils or even a thin layer of fine, hard gravel. This last proposition especially provides an economical cure for rough surfaces.

Many things can be said regarding the construction and up-keep of water-bound macadam, and an article entering into all the details would involve a regular course in construction work. The writer has treated the subject briefly and only from the point of view of the Province of Quebec.

PERSONALS

FRANK BARBER, consulting engineer, Toronto, whose design for the $300,000 Hunter Street bridge, Peterborough, Ont., which will be the longest concrete arch bridge in Canada, was formally accepted by the city of Peterborough last week by the mayor's signing the constract for its construction, was born December 27th, 1875, at Milton, Ont., and was educated at the Dunnville high school, Mount Allison University and the University of Toronto, where he graduated in 1906 in the civil engineering course, specializing in mathematics. After graduation Mr. Barber entered the office of the late James MacDougall, who was then engineer of York County, Ont., and later became Mr. MacDougall's chief assistant. Upon Mr. MacDougall's death in 1908, Mr. Barber entered private practice and was also appointed York County engineer. Mr. Barber was in partnership with C. R. Young, who is now an associate professor at the University of Toronto, under the firm name of Barber & Young, until 1911, when Mr. Young joined the staff of the University as a lecturer. From 1908 until the outbreak of war, Mr. Barber and his staff designed and planned an average of about thirty bridges a year in various parts of Canada, including the longest concrete arches and some of the longest steel highway bridges in Ontario, also including the first open spandrel arches in Canada and fifteen out of the first twenty concrete truss bridges in the Dominion. At the outbreak of war, when bridge work partially stopped, Mr. Barber became managing-director of the Thor Iron Works, Ltd., Toronto. This plant was soon converted into a shipbuilding yard, and in 1917 launched its first ocean-going steel freighter. Under Mr. Barber's management the business is said to have increased from $200,000 to over $1,000,000 a year. In October, 1917, he sold his interests in the firm to New York shipbuilders who reorganized the business as the Dominion Shipbuilding Co., and Mr. Barber decided once more to devote his entire time to consulting work. He is at present corporation engineer or consulting bridge engineer for the counties of York, Simcoe and Haldimand, and the townships of York, Vaughan, Etobicoke, King and various other townships and towns. During the past two years he has acted in association with R. O. Wynne-Roberts for various water works, sewerage and other municipal improvements, including water works extensions costing about $1,000,000 for York Township. The firm is now reporting on a sewerage scheme for York Township which will also cost about $1,000,000.

WILLIS CHIPMAN, of the firm of Chipman & Power, consulting engineers, Toronto, is in British Columbia (Vancouver Island) on an engineering mission for the Dominion Government.

CHARLES R. MURDOCK, who for the past nine years has been on the staff of Chipman & Power, consulting engineers, Toronto, has resigned to accept an appointment as town engineer of Dundas, Ont. Mr. Murdock graduated in 1906 at the University of Toronto, with the degree of B.A.Sc. He was formerly resident engineer for Chipman & Power at that firm's Winnipeg office.

NORMAN MALTMAN, formerly purchasing agent of the Russell Motor Car Co., Toronto, has joined the staff of A. R. Roberts, Toronto, who recently severed his connection with the firm of Burns & Roberts, Ltd., and opened a new office as manufacturers' agent and dealer in new and used machinery.

OBITUARY

A. C. MACKENZIE, who was for many years an outstanding figure in the construction world of Western Canada, died suddenly last Friday at the power plant which is under construction on the Winnipeg River. Mr. MacKenzie was 56 years of age. He was president of the Northern Construction Co., who are the contractors for the Winnipeg River power plant. For over 20 years he was one of the best known railway contractors in Western Canada, having been actively identified with the C.N.R. interests. Interment took place last Monday at Beaverton, Ont.

EFFECT OF VIBRATION, JIGGING AND PRESSURE ON FRESH CONCRETE

(Continued from page 192)

23. The compressive strength of concrete was increased by pressure applied immediately after moulding. For pressure of 200 to 500 lbs. per sq. in. the increase was 20 to 35%.

24. The duration of pressure as between 15 mins. and 16 hrs. produced no difference in strength.

25. There was a steady reduction in the water-ratio of the concrete with the application of pressure.

26. The application of pressure increased the strength of concrete in accordance with the quantity of mixing water expelled.

27. The tests of concrete subjected to pressure showed the usual relation between compressive strength and water-ratio. The strength is increased *because the water is expelled.* In other words, pressure produces a drier concrete, and, consequently, gives higher strength. This makes it clear why the duration of pressure has no influence on the result.

The indications of the vibrations and jigging tests should not be misinterpreted. The tests show that *after the concrete is properly placed* these methods of treatment do no good, and may be harmful if too severe or too long continued. However, there can be no doubt of the value of such methods *for getting concrete into place* in intricate forms and around reinforcing bars. The tests are of value in showing that this is the only desirable function of such treatments. One series of tests shows the ill effects of lack of compactness in the concrete, the strength being reduced 13% due to failure to tamp or puddle the top 9 ins. of the cylinder. It is impracticable to duplicate in a compression test piece the performance of air hammers and other similar methods of vibrating when used on reinforced concrete work.

The tests show that with jigging high strength may be secured with drier mixes than would be feasible otherwise. It is a matter of common experience that concrete of drier consistency (and, consequently, higher strength) can be placed by means of jigging or vibration than would be possible by the usual methods.

There are already thirty-two surrendered German aeroplanes assembled at Toronto, and all will be displayed or flown at the Canadian National Exhibition, August 23rd to September 6th. Canada owns nearly 100 German or allied planes, and they will eventually become part of the official museum display or be distributed among the various cities by the Dominion government.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand or proposed, contracts awarded, changes in staffs, etc.

BRIDGES, ROADS AND STREETS

Andover, Victoria County, N.B.—The provincial department of public works is calling for tenders for construction of roadway embankments.

Banff, Alta.—The road from Banff, eastward to the park limits, will be improved. Estimated cost, $14,000. Superintendent Wardle, Banff Park.

Belleville, Ont.—Recent by-laws passed by the city council provide for the construction of granolithic sidewalks, $16,635.06 and pavements, $17,756.50. J. Wilfred Holmes, city clerk.

Belleville, Ont.—The city council contemplates construction of asphaltic concrete pavements on Pinnacle St., cost, $25,963.40; Coleman St., $19,182.32; Ann St., $12,228.20; Campbell St., $3,633.03; George St., $26,811.70; Burnham St., $13,972.40, and William St., $11,778.90. J. W. Holmes, city clerk.

Birtle, Man.—Contract has been awarded for construction of three bridges to La Cour and Schisler, Winnipeg. Contract price, $3,100. W. B. Chapman.

Bishop's Crossing, Que.—Tenders will be received until noon, August 2nd, for construction of part of the Beauce Junction-Sherbrooke road, in Dudswell, from the town line of Weedon to the town line of Marbleton. H. Cunningham, secretary-treasurer.

Brantford, Ont.—Plans are being prepared by the city engineer to pave West St., connecting with the county road pavement.

Calgary, Alta.—The Dominion and British Columbia governments have agreed to complete the construction of the Calgary-Windermere section of the highway. Estimated cost to complete, $2,500,000. J. W. Davidson, Calgary.

Cloverdale, B.C.—The Surrey council has decided to repair roads. Estimated cost, $1,000.

Edmonton, Alta.—The department of works will recommend paving the north side of Norwood Blvd., from 95th to 97th St. City Engineer Haddow.

Glenwood, Man.—The municipal council will proceed with their program of road improvement, under the terms of federal and provincial grants.

Langier, N.S.—A meeting of ratepayers from the eastern district of Halifax county will urge the provincial government to reconstruct all the main roads. G. Mason, secretary.

Lincoln, N.B.—The contract for the Harris bridge in the parishes of Lincoln and Burton, Sunbury county, has been awarded to Frank L. Boone, South Devon. Contract price, $51,000.

Lindsay, Ont.—Tenders will be received until 2 p.m., August 5th, by J. R. McNeillie, county clerk, for construction of a 40 ft. concrete arch truss bridge at concession 4, lot 16, Mariposa township; a 16 ft. Flynn concrete bridge, at concession 10, lot 11, Emily; a 16 ft. West cross creek bridge, Township of Ops. Engineers, Bowman and Connor, Toronto.

L'Orignal, Ont.—Contract has been awarded to Grant Bros., Ottawa, for construction of 5 miles of the Montreal-Ottawa Rd., east of Orleans. This will be a bituminous road, 16 ft. in width and is to be completed this fall. Contract price, bituminous binder, 34 cents per sq. yd.; loose metal per cu. yd., $3.35. Victor Belanger, engineer.

McGillivray Township, Ont.—Tenders will be received until 1 p.m., August 2nd, by the county council for excavating hill and widening grade on county road. Charles Talbot, county engineer, county building, London, Ont.

Moncton, N.B.—The city council has awarded the contract to the Warren Bituminous Paving Co., Ltd., for paving the following streets: Highfield St., from St. George to John St.; High St., from No. 4 fire station to John St.; King and Union Streets, from the city hospital to Botsford St.; and John St., from High to Highfield Sts. The contract also calls for the laying of bitulithic topping on Highfield and Botsford Sts. City engineer, Edington.

Montreal, Que.—Luna Park, Ltd., will construct additions to bridge at Back River. Estimated cost, $15,000. Architect, L. Lemieux, 364 University St.

Montreal, Que.—The department of works will proceed with paving St. Lawrence St. The concrete base has been laid over two years and will be repaired. Estimated cost, $35,000. Chief engineer, Doucet.

Moorefield, Ont.—Tenders will be received until 11 a.m., August 4th, by the township of Maryboro, for construction of a 55 ft. steel bridge at lot 6, concession 15. W. W. Scott, town clerk. Engineers, Bowman and Connor, Toronto.

Moose Jaw, Sask.—By-law will be submitted to the ratepayers on August 7th, authorizing debentures for repairs to roadway of Fourth Ave. s.w. bridge. Estimated cost, $16,000. R. P. Riddell, city clerk.

Murrayville, B.C.—Langley council will repair and construct roads. Estimated cost, $2,110.

Oakville, Ont.—The contract was awarded to George McLaren, town foreman, for building tarvia roads on Navy, Dunn, Reynolds, Howard and Douglas Streets.

Orangeville, Ont.—Tenders will be received until 2 p.m., August 11th, for construction of the following reinforced concrete culverts, bridges and abutments: In the county of Dufferin, bridges—7 of 10 ft. span, 2 of 12 ft., 1 of 14 ft., 1 of 16 ft., 1 of 20 ft., 1 of 22 ft., 3 of 24 ft.; culverts—1 of 4 ft. span, 4 of 6 ft., 1 of 8 ft. In the township of Albion—1 pair of abutments for a 55-ft. steel truss, 1 pair of abutments for a 48-ft. steel truss. In the township of Toronto Gore—1 bridge, 32 ft. span. In the township of Toronto—1 bridge of 12 ft. span. Wheelock and Christie, engineers, Orangeville, Ont.

Owen Sound, Ont.—The board of works will send a deputation to Toronto to examine different classes of roads under construction before awarding contracts recently opened.

Park's Brook, N.B.—Contract has been awarded for the Park's Brook (Mouth) bridge, Northumberland county, to D. C. Burpee and Son, South Devon. Contract price, $9,000.

Peterboro, Ont.—The mayor formally signed the contract last week for the Hunter St. bridge, and the successful contractors, Russell, Townsend & Co., of Toronto, have two car loads of plant now on the job, and Mr. Christie, assistant engineer in the office of Frank Barber, consulting engineer, Toronto, is here laying out the work.

Point Edward, Ont.—Tenders will be received until August 1st by the board of works for construction of concrete sidewalks on Alfred and Monk St. Wm. H. Barrett, chairman.

Saskatoon, Sask.—Tenders will be received until about August 12th by the highways department of the provincial government for construction of three new steel and concrete bridges, to be located at Tisdale, Benito and Wascana Creek.

South Vancouver, B.C.—Tenders are called for hard-surfacing of Fraser Ave., from 59th St. to Marine Drive. Municipal council.

Stamford Township, Ont.—Sealed tenders will be received until 8 a.m., August 4th, by the township council for construction of concrete walks, section No. 9. Township

clerk, C. F. Monroe. Engineer, J. C. Gardner, Niagara Falls, Ont.

St. David de L'Auberiviere, Que.—Tenders will be received by the Levis Road Commission until August 4th for a cement pavement. Secretary, Arthur Pigeon, government building, Quebec, Que.

St. Telesphore, Que.—Tenders will be received until August 4th by the Levis Road Commission for a steel bridge over the Scie River. Secretary, Arthur Pigeon, government building, Quebec, Que.

Toronto, Ont.—Tenders will be received until noon, August 11th, by the department of works, city hall, for construction of the following pavements, curbs and sidewalks: Pavements, asphalt—Cawthra Ave., from Junction Rd. to 264 ft. south; Elm St., from Yonge St. to Chestnut St. (except the intersections of Teraulay and Elizabeth St.); Front St., from York to Simcoe St.; Grosvenor St., from Yonge to Queen's Park (except intersection of Surrey Pl.); Heintzman Ave., from Dundas St. to north end; Monarch Rd., from Weston Rd. westerly and southerly to south end; Pendrith St., from Christie to 200 ft. east of Shaw St.; Silverthorne Ave., from St. Clair to Rowntree Ave. Bitulithic—Exeter Ave., from Laughton Ave. to east end. Brick block—Silver Birch Ave., from Queen St. to 1,100 ft. north. Grading—Drayton Ave., from Danforth Ave. to 220 ft. south of Hanson St. Concrete curbs—Annette St., S.S., from Indian Gr. to Keele St.; Grosvenor St., both sides, from Surrey Pl. to Queen's Pk.; Prescott Ave., E.S., from St. Clair Ave. to East Ave.; Silverthorne Ave., E.S., from 206 ft. south of Howick Ave. to 152 ft. farther south.; Silverthorne Ave., W.S., from 239 ft. south of Howick Ave. to 86 ft. farther south; Silverthorne Ave., W.S., from Turnberry Ave. to Rowntree Ave. Concrete sidewalks—Drayton Ave., both sides, from 220 ft. south of Hanson St. to Danforth Ave.; Jones Ave., W.S., from 153 ft. south of Mallon to 310 ft. farther south; King St. West, N.S., in front of Nos. 22, 24, 26 and 28; Moutray St., N.S., from Sheridan to Brock Ave.; Neville Park Blvd., E.S., from Queen to west limit of lot No. 50. T. L. Church, chairman, board of control.

Toronto, Ont.—Tenders will be received until 12 o'clock noon, August 18th, by the department of public highways, Toronto, for the necessary grading and bituminous road construction on the following sections of the provincial highway: Section No. 1, from the easterly limit of the city of London to the westerly limit of the town of Ingersoll, 15.93 mls. Section No. 2, from the easterly limit of the city of Brantford to the village of Ancaster, 15.62 mls. Section No. 3, from the easterly limit of the village of Beamsville easterly a distance of 3.25 mls. Section No. 4, from the easterly limit of the town of Trenton to the westerly limit of the city of Belleville, 9.13 mls. Section No. 5, from the westerly limit of the city of Kingston to the westerly limit of the township of Kingston, 7.72 mls. Section No. 6, from the easterly limit of the city of Brockville to the westerly limit of the town of Prescott, 10.46 mls. (Official advertisement in this issue.)

York Township, Ont.—Tenders will be received until 10 a.m., August 5th, for construction of concrete sidewalks on Westwood and Hillbrow Ave. (Official advertisement in this issue.) Frank Barber, township engineer, 40 Jarvis St., Toronto.

WATER, SEWAGE AND REFUSE

Belleville, Ont.—Contracts have been awarded by the city council to J. C. Wilde for construction of sewers on Yeomans, Cedar, Boswell and Isabel Sts. Contract price, $16,043.45. J. W. Evans, city engineer.

Belleville, Ont.—Recent by-laws passed by the municipal council provides for the construction of sewers. Estimated cost, $32,871.06. J. Wilfred Holmes, city clerk.

Burlington, Ont.—Contract has been awarded for the construction of sewers to D. O. Johnson, of Johnson Bros., Brantford, Ont. Mr. Johnson will supply the required vitrified pipe. Contract price, $18,200. Consulting engineers, Chipman & Power, Toronto.

Burnaby, B.C.—Westminster council has decided to proceed with the construction of the Glenbrook sewer.

Dundas, Ont.—Contracts for sewer construction and sewage disposal plant have been awarded by the council as follows: For sewers, to F. F. Fry, Toronto, $126,757; for disposal works, pump-house, etc., F. F. Fry, Toronto, $49,676.60; ejectors and piping, John Bertram & Sons Co., Dundas, $1,500; air compressors, motors and air tank, Smart-Turner Co., Hamilton, $2,659; cast-iron pipe and specials. Gartshore Pipe and Foundry Co., Hamilton, $2,445.40; sprinkler equipment, valves, etc., for disposal works, Francis Hankin Co., Montreal, $6,888.30; sewer pipe, Hamilton and Toronto Sewer Pipe Co., Ltd., Hamilton, $23,866.84; segment block (30-in.), Toronto Pottery Co., Toronto, $10,175. Total amount of contracts, approximately $225,000. The system will be built from plans and specifications prepared before the war by the former firm of Murray & Lowes, consulting engineers, Toronto, who estimated the cost of the system at that time at $150,000. There was considerable competition for the sewer contracts, the following tenders having been received in addition to Mr. Fry's: R. A. C. Smith, Hamilton, $128,000; J. J. Armstrong & Sons, Hamilton, $130,000; Canadian Engineering and Contracting Co., Hamilton, $152,000; Kerr & Clement, Orillia, Ont., $155,000; Connolly-Agnew Construction Co., Toronto, $228,000. The competition for the disposal works was practically confined to Mr. Fry and the Connolly-Agnew Construction Co., who bid $50,325.05. The sewage disposal plant will be concrete and brick. Work will be started at once, and Mr. Fry expects to finish the disposal works this year and the sewers by the end of next summer.

London, Ont.—Tenders will be received until noon, August 4th, for excavating Oxbow Creek drain. M. Grant, township clerk, London, Ont. F. W. Farncomb, engineer, London.

Moose Jaw, Sask.—By-law will be submitted to the ratepayers on August 7th authorizing debentures for extensions to waterworks at Britannia Park. Estimated cost, $40,000. R. P. Riddell, city clerk.

New Toronto, Ont.—The plans for new water mains have been approved by the provincial board of health. Active construction of the system will now be carried out on 16th, 10th and 4th Sts. Estimated cost, $18,000.

North Bay, Ont.—Sealed tenders will be received until 12 o'clock noon, August 1st, by the fire, water and light commission, for the construction of the following water mains: Worthington St., from John to Metcalf; McIntyre St., from Regina St., 400 ft. westerly; Hardy St., from John St. easterly; Second Ave., from Wyld to Ferguson St.; Fourth St., from Cassells St., 400 ft. southerly; McIntyre St., from a point midway between Ferguson and Fraser Sts., 100 ft. easterly. E. C. Rheaume, chairman.

Owen Sound, Ont.—By-law was introduced providing for sewers to be constructed as local improvements on 2nd Ave. West and on 10th St. West. C. H. Thompson.

Peterboro', Ont.—The city council contemplate construction of a sewage disposal plant. This project was under consideration in 1914, but was postponed. The townships of Otonabee and the two Monaghans have threatened an injunction to restrain the city from dumping raw sewage into the river. E. A. Peck, solicitor for townships.

Toronto, Ont.—The department of works will lay new 24 in. diam. cast-iron water mains along Withrow, Pape and other streets to relieve the water scarcity in North Riverdale district.

Walkerville, Ont.—Tenders will be received until August 12th by the Essex Border Utilities Commission for the construction of a sewerage pumping station. G. M. McGregor, chairman; W. M. Baxter, secretary, Room 14, Victoria Block, Windsor, Ont.

Waterloo Township, Ont.—Contract has been awarded to Crawley and Gaunt, Arthur, Ont., for construction of municipal drain No. 2. Contract price, 50 cents per cu. yd. P. A. Snider, Breslau, Ont.

Welland, Ont.—Contract has been awarded to Somerville and Dilworth for sewer on Fisher St., contract price, $780.50. Rejected tender, Martin Miller, $1,050. City engineer, Chas. L. Coulson.

Windsor, Ont.—Tenders for constructing the Walkerville sewerage pumping station, in connection with the intercepting sewer now being constructed through the Essex County border cities, will be received by the Essex Border Utilities Commission, Victoria Block, Windsor, until August 12th. Five dollars deposit required on plans and specifications.

Woodstock, Ont.—Dr. Andrew McKay, medical officer of health, has reported pollution in the domestic water supply taken from Cedar creek, as a result of the inflow of city sewage, and has requested that the city council take immediate action to remedy conditions.

LIGHT, HEAT AND POWER

Chatham, Ont.—The Chatham, Wallaceburg and Lake Erie Ry. will be operated under hydro power within six weeks. Two 250 k.w. rotaries will be installed in Chatham, one at Wallaceburg and one at Cedar Springs. Mr. Curte, manager.

Vancouver, B.C.—The report of the Commission of Conservation places the total estimated 24 hour horse-power available from the water powers of British Columbia to be 3,000,000.

Winnipeg, Man.—The Winnipeg River Power Co., will develop power from the Bonnet Falls, 75 miles north-east of Winnipeg. This plant will have an ultimate capacity of 168,000 h.p. in six units, each of 28,000 h.p.

RAILWAYS

Cobourg, Ont.—The Hydro Commission contemplates taking over the Ontario Eastern Electric Railway and extending same to Kingston.

Copper Mountain, B.C.—Construction has again commenced on the branch railroad running to Copper Mountain from the Kettle Valley Ry. Contractors, Tierney Bros.

Halifax, N.S.—The Canadian National Railways has awarded contracts for double-tracking the main line from Halifax to Moncton, N.S.; one section in New Brunswick and one section in Quebec. Work will start immediately.

The Pas, Man.—The Canadian National Railways have absorbed the Hudson Bay Railway. Ten miles of construction will probably be completed this year to connect with the Nelson River.

Toronto, Ont.—Construction of the Toronto-Niagara hydro radial line will probably commence soon. Engineers are checking up on the surveys and the right-of-way will then be acquired. Sir Adam Beck, chairman, Hydro-Electric Power Commission.

FACTORIES AND LARGE BUILDINGS

Brantford, Ont.—An electric tin smelting plant will be established on property adjoining that of the Verity Plow Co.

Brantford, Ont.—The Cockshutt Plow Co., will make extensive additions to their plant. Estimated cost, $100,000.

Brantford, Ont.—The Brantford Roofing Co. has commenced construction of an extension to the boiler plant. Estimated cost, $5,000.

Brantford, Ont.—The Brantford Scale Co. has awarded a contract for erection of an addition to their present plant. Plans are being prepared to double the capacity of the plant by further additions.

Brantford, Ont.—The Cockshutt Plough Co. has commenced construction of an additional storage warehouse, estimated cost, $9,500, and an experimental building, estimated cost, $15,000.

Bridgeville, N.S.—Tenders will be received by the school board until August 30th, for construction of an addition to the school at Bridgeville, county of Pictou. P. L. Lithgow, secretary, R.R. No. 1, Eureka, N.S.

Calgary, Alta.—R. F. Baxter, 1111 Tenth Ave., will erect an addition to his warehouse. Estimated cost, $3,000.

Calgary, Alta.—The contract for the new post office to be erected here will be awarded during August. Major L. Redman, M.P.

Creston, B.C.—A new high school building will be erected in the school property. Chas. Moore, chairman.

Creston, B.C.—The ratepayers of the Creston school district have decided to erect a new school building. Estimated cost, $6,000.

East Toronto, Ont.—Four public schools or additions to present schools will be constructed during this summer, in the east end of the city.

East Toronto, Ont.—George and Moorehouse, architects for the Norway School on Kingston Rd. Estimated cost, $45,000. John Siddall, architect for a three-story addition to the Duke of Connaught School. Estimated cost, $45,000. Ellis and Ellis, architects for administrative section to be added to the North Leslie St. School. Estimated cost, $90,000. E. G. Bird, architect for three-story addition to Earl Grey School. Estimated cost, $50,000.

Edmonton, Alta.—Tenders will be received until 12 o'clock noon, August 7th, by the department of public works for construction of Principals' residences at the Agricultural schools, Vermilion, Claresholm and Olds. I. C. Charlesworth, deputy minister.

Edmonton, Alta.—The new telephone exchange, to have an ultimate capacity of 14,000 lines, will be constructed immediately, to be completed by January, 1920. J. Lowry, superintendent.

Edmonton, Alta.—The tenders for the Keith sanitarium as submitted were considered too high. Excavation work to the extent of $55,000 has already been done, and it is probable that the remainder of the construction and installation of mechanical equipment will be done by day labor, or on a percentage basis.

Fort Garry, Man.—The municipality will construct new houses under the provisions of the Federal Housing Act. Estimated cost, $100,000.

Fort William, Ont.—The Western Elevator Co. will erect a reinforced concrete building to be used for garage, lunch room, etc. Estimated cost, $20,000.

Galt, Ont.—The city council has decided to build a new grand stand in Dickson Park. Estimated cost, 15,000.

Glace Bay, N.S.—Contract has been awarded to Joseph McKinnon for construction of central school.

Guelph, Ont.—The Ontario Agricultural College will erect a memorial hall in honor of their soldier students. Estimated cost, $100,000.

Halifax, N.S.—Tenders will be received until noon, August 30th, by the board of the school commissioners, for construction of four new schools, complete with lighting and heating. S. J. Wilson, secretary.

Halifax, N.S.—The Salvation Army contemplate construction of a new maternity home to accommodate about 75 beds. Col. G. Miller, property secretary.

Hepworth, Ont.—A new glove factory will probably be located here. The motive power for the factory is to be natural gas.

Hull, Que.—Contract has been awarded by the department of agriculture to Doran and Devlin, Ottawa, for construction of a cattle barn at the research station, Hull, Que. contract price, $5,380.

Indian Head, Sask.—Tenders are called until August 12th by the department of public works, Ottawa, for construction of a brick office building for the forestry branch. Plans, etc., at resident architect's office, Winnipeg, and at the chief architect's office, Regina. R. C. Desrochers, secretary.

Kentville, N.S.—A combined hospital is being planned as soldiers' memorial for the surrounding counties. W. H. Chase, chairman of the memorial executive.

Kingston, Ont.—The United Hotel Co., Niagara Falls, N.Y., will prepare plans for new hotel. F. A. Dudley.

Kitchener, Ont.—The Canadian Consolidated Rubber Co., Ltd., Montreal, has decided to increase their plant in Kitchener. Estimated cost, $1,000,000.

Lindsay, Ont.—Contract for the new main hall at the fair grounds will not be awarded until September.

Markdale, Ont.—Tenders will be received until August 7th by J. E. Marsh for rebuilding of Markdale hotel.

Midland, Ont.—An addition to the hospital will probably be erected as a soldiers' memorial. J. McDowell, mayor.

Moncton, N.B.—Additional building permits include an I.C. Ry. freight shed, French academy, moving picture building and dwellings. Estimated cost, $900,000.

Moncton, N.B.—Contracts have been awarded by the Canadian National Railways for the following section houses; Picard, Que., Lapointe, Que., Bretagne, Que. and Lefebvre, Que., to A. J. Morin, of Garthby, Que. Near Grog Brook, N.B., and Sirois, N.B., to Hamilton and Collier, of Campbellton, N.B. Grog Brook, N.B., to Isreal Roy, Green Point, N.B. Chief engineer, C. B. Brown.

Montmartre, Sask.—Contract has been awarded by the Sisters of Forget to S. Pritchard, Moose Jaw, for construction of new convent. J. E. Fortin, architect, Gravelbourg. Estimated cost, $50,000.

Moose Jaw, Sask.—A by-law will be submitted to the ratepayers on August 7th, to authorize debentures for construction of a public comfort station. Estimated cost, $13,000. R. P. Riddell, city clerk.

New Westminster, B.C.—Contracts have been awarded by the executive of the R. A. and I. Society for construction of the hog and swine building to Archie Hogg. The poultry and sheep sheds were awarded to J. Hetherington.

New Westminster, B.C.—The school board will erect a four-room addition to the Herbert Spencer school and will soon call for tenders.

North Wiltshire, P.E.I.—Contracts have been awarded by the department of public works, Ottawa, for construction of medical officers' residence, $14,950, Vocational building, $30,476 and pump house, $2,180, to Henry J. Phillips, Charlottetown, P.E.I. R. C. Desrochers, secretary.

Oakville, Ont.—The town council has granted the school board $22,000 to construct a new school building.

Port Arthur, Ont.—The local housing committee have requested the city council to prepare a by-law covering debentures for construction of houses. Estimate of cost, $250,000. J. A. Miskimmins, vice-chairman.

Regina, Sask.—Sub-contracts have been let by Wilson and Wilson, general contractors for the heating and plumbing at the Eastern Annex school, to Potts and Smith; sheet metal work to Hastings and Willoughby, Regina.

Regina, Sask.—The new barracks for the Royal Northwest Mounted Police will be built this summer. Date of completion probably November 1st. Storey and Van Egmond, architects. A new chapel, three houses for officers and a row of three houses for the N.C.O.'s will probably be erected next year.

Saskatoon, Sask.—Contract for the new elevator for the Quaker Oats Co. has been awarded to the Leonard Construction Co. It is to be of reinforced concrete throughout, and construction will commence about August 1st.

St. John, N.B.—The Salvation Army has awarded contract for construction of a new wing to the Maternity Home. A similar hospital is planned for Halifax, N.S. Estimated cost of both hospitals, $750,000. Col. G. Miller, property secretary.

Strathroy, Ont.—Tenders will be received until August 8th by the Dominion Canners for construction of a process-room, boiler and engine-room, etc. Thomas Wooster, Aylmer, Ont.

Sudbury, Ont.—The separate school board contemplates construction of a new school. Estimated cost, $10,000. John Frawley, secretary.

Thorold, Ont.—The town council will proceed to construct houses under the provincial housing act. Estimated cost, $50,000.

Toronto, Ont.—The city architects department issued seven permits on July 21st for construction of houses. Total value, $39,600.

Toronto, Ont.—The Imperial Oil Co. have received permission from the city council to establish a free air service station and public lavatory at the corner of Bloor and Dundas Sts. Estimated cost, $20,000.

Toronto, Ont.—The Silverthorne branch of the G.W.V.A. are constructing a new club house. J. F. Ross, president.

Trenton, Ont.—J. B. White, government arbitrator will value 70 lots expropriated by the Trenton Housing Commission. Houses will be built on these lots under the terms of the provincial housing act. Estimated cost of houses, $200,000.

Truro, N.S.—Tenders will be received until August 8th for construction of the maritime home for girls. Separate tenders are asked for plumbing and heating. R. W. Ross, president, Halifax, N.S.

Vancouver, B.C.—A sub-committee of the Reconstruction league will endeavor to have the auditorium project completed and construction started. Members of committee, G. P. Hicks, G. H. Howker, J. Leyland and Frank Wrigley.

Vancouver, B.C.—A technical school will likely be established here. The site and $25,000 in equipment is available. Probable cost, $250,000. Mrs. Moody, chairman of committee.

Wadena, Sask.—Contract has been awarded to Ross and Co., Saskatoon, for construction of a new union hospital. Contract price, $25,500. Dr. M. M. Seymour, commissioner of public health for Saskatchewan. Architect, N. L. Thompson, Saskatoon.

Winnipeg, Man.—Gordon, Ironside and Fares will construct an addition to their present plant. Estimated cost, $10,000.

Windsor, Ont.—The city council contemplates construction of a new eight-room addition to the Dougall Ave. school. Estimated cost, $65,000. M. A. Dickinson, acting clerk.

Winnipeg, Man.—The Maple Leaf Milling Co. are remodelling some of their 50 elevators situated in the west.

Welland, Ont.—The city council will borrow $250,000 from the province under the federal and provincial housing scheme to construct workmen's houses.

Yarmouth, Ont.—A new memorial school will be built at Locke's and an addition added to the Height's school. Combined estimate of cost, $22,000. W. Hill, Yarmouth.

York Township, Ont.—Seventy-five applications for houses have been received by the housing committee. Contracts have been prepared for 13 houses, which will be erected at once.

MISCELLANEOUS

Andover, Victoria County, N.B.—The department of public works is calling for tenders for construction of the McKinnon concrete arch culvert.

Anse aux Gascons, Que.—Tenders will be received until 12 o'clock noon, August 14th, by the department of public works, Ottawa, for construction of wharf. Plans, etc., at the offices of the district engineers, Rimouski, Que.; Post Office building, Quebec; Shaughnessy building, Montreal; and at the post office, Gascons, Que. R. C. Desrochers, secretary.

Belleville, Ont.—A meeting of property owners will consider buying some 7,000 acres of land adjacent to the city of Belleville from the Grand Trunk Ry. They propose to convert this into a large industrial district, taking advantage of the provincial housing act. W. C. Mikel, K.C., Belleville, Ont.

Calgary, Alta.—Construction of the Taber district irrigation project will be commenced at once and completed during June, 1920. Estimated expenditure, $200,000. Acreage to be irrigated 17,500. T. A. Sundal, Taber, Alta.

Cargill, Ont.—The new organization, under the name of Cargill, Ltd., will operate the electric light and power plant,

No Damage at these Curves!

Entrance to Queen Victoria Park, Niagara Falls, Ont. Roadway surface treated in June 1918 with "Tarvia-B."

When swift and heavy automobiles sweep around the bend of an ordinary macadam road the tires slip sidewise—not enough to skid, to be sure, but enough to rub and rasp the brittle macadam until the stones loosen and the surface ravels.

No road is better than its curves.

The curves are always the first spots in a road that need repair.

With plain macadam construction the curves are a *constant source of trouble and expense.*

Not so with Tarvia-macadam: Note the excellent condition of the curves in the Tarvia roads pictured here.

Curves have no terrors for Tarvia, because when it is used as a binder it forms a tough matrix for the crushed stone. Not only has Tarvia greater bonding power than natural binder, but it has the further element of *plasticity*, so that it yields instead of crumbling.

Tarvia solves motor-traffic problems.

The use of Tarvia reenforces the road-surface and makes it strong enough to resist motor-driven traffic, which to-day is the biggest problem of the roadmaker.

Likewise with the erosion problem: Water on steep grades washes out plain macadam but does not harm the Tarvia-macadam because it is absolutely waterproof.

And remember, Tarvia roads are also *frost-proof, mudless, and dustless,* and cost less than any other type of good-road construction.

Illustrated booklet describing the various Tarvia treatments free on request.

The Barrett Company LIMITED

MONTREAL TORONTO WINNIPEG VANCOUVER
ST. JOHN, N.B. HALIFAX, N.S. SYDNEY, N.S.

Summit Crescent, West Crescent Height, Westmount, a suburb of Montreal. Treated with Tarvia.

Special Service Department

This company has a corps of trained engineers and chemists who have given years of study to modern road problems. The advice of these men may be had for the asking by any one interested. If you will write to the nearest office regarding road problems and conditions in your vicinity, the matter will have prompt attention.

Main Driveway, Queen Victoria Park, Niagara Falls, Ont., north of the Administration Building.

saw mill, stave and lath mill, planing mill, flour mill, foundry and, perhaps, a new toy factory. W. C. Trapp, managing director.

Cornwall, Ont.—A terminal pulp company will operate from Cornwall, if bonds are guaranteed. This company will handle pulpwood and lumber from the forests of Quebec and New Brunswick destined for pulp mills in New York State. H. Dow, reeve, township of Cornwall.

Cornwall, Ont.—Tenders will be received until 12 o'clock noon, August 12th, by the department of railways and canals, Ottawa, for the rebuilding and extension of wharf, lock 17-18 level. Plans, etc., at the offices of the chief engineer, Ottawa; superintending engineer, Cornwall, Ont. J. W. Pugsley, secretary.

Fort William, Ont.—The Ogilvie Flour Mills Co. will construct a new concrete dock along the waterfront of the company on the Kaministiquia River.

Fort William, Ont.—Pavement on Victoria Ave. will soon be relaid by the department of works. Concrete and dollarway has been recommended by the city engineer.

Glace Bay, N.S.—Bate-McMahon Co. have resumed their contract for loading gravel at Dixon's platform, loading at the rate of 300 tons per day.

Hamilton, Ont.—The board of harbor commissioners will request the Dominion government to make an early start on the harbor improvement program for which appropriation was made recently.

Marysville, N.B.—The Ambursen Hydraulic Construction Co., of Canada, Ltd., has been awarded contract for a dam and water power development for the Nashwaak Pulp and Paper Co., Ltd.

Midland, Ont.—Contract has been awarded by the department of public works, Ottawa, to W. H. McArdle, Midland, for repairs to wharf. Contract price, $3,291.30. R. C. Desrochers, secretary.

Midland, Ont.—Contracts have been awarded by the department of public works, Ottawa, for renewals to government wharfs Nos. 1 and 2 at Midland, to Wm. Henry McArdle, Midland, Ont. Secretary, R. C. Desrochers.

Midland, Ont.—Tenders will be received until 5 p.m., August 1st, by the town council for excavating, laying and backfilling 790 lin. ft. of sewer. Tenders will also be received for the above work, including supply of 8-in. tile and tees. C. E. Smith, town clerk.

Moncton, N.B.—City council has decided to extend the water mains to Georgetown, installing a 12-in. main. Mayor Price.

Montreal, Que.—Contract has been awarded to the Raymond Concrete Pile Co., Ltd., Montreal, for the piling required for the Nurses' Home, Western Hospital, Montreal.

Montreal, P.Q.—Wonham, Bates and Goode, Inc., Montreal, have sold a 15-ton, eight wheel Orton and Steinbrenner locomotive crane, with 40-in. electric magnet, to the Canadian Rolling Mills.

Moose Jaw, Sask.—The Romans' Machine and Repair Co., have applied to the city council for permission to use the buildings formerly occupied as munition plant to operate an iron and brass foundry.

Nanaimo, B.C.—The Nanaimo Automobile Club will urge the construction of an automobile elevator to be installed at the docks for use at low tide. J. F. Edge-Partington, secretary.

Odessa, Ont.—Tenders will be received until 12 o'clock noon, August 8th, by the department of public highways, Toronto, for construction of the concrete abutments, concrete roadway and sidewalk floors for bridge. Plans, etc., at the office of the resident engineer, Napanee; city engineer, Kingston, and department of highways, Toronto. W. A. McLean, deputy minister. (Official advertisement in this issue.)

Ottawa, Ont.—Contract has been let by the department of public works for supply of electric fixtures and lamps for the Hunter building, Ottawa, to A. A. Giddings and Co., Montreal. Contract price, $9,981.45. Tenders received ranged from $9,981.45 to $13,194. R. C. Desrochers, secretary.

Ottawa, Ont.—Tenders will be received until August 30th for pumps, engines, blowers, boilers, radiators and various other unused articles, now at the Kingston Penitentiary, Kingston, Ont. W. S. Hughes, Superintendent of Penitentiaries, Department of Justice, Ottawa. (See official advertisement on another page of this issue.)

Ottawa, Ont.—The following item appeared in this column in the July 17th issue: "Contract for dredges P.W.D. No. 110 and P.W.D. No. 116 has been awarded by the Department of Public Works to M. Beatty & Sons, Ltd., Midland, Ont." There were two errors in this item. The address of M. Beatty & Sons, Ltd., is Welland, Ont., not Midland. The contract was not for dredges, but for three dipper handles, two for dredge No. 110 and one for dredge No. 116.

Owen Sound, Ont.—By-law has been introduced for concrete curbs on several streets. C. H. Thompson.

Pictou, N.S.—Tenders will be received until 9 o'clock a.m., August 7th, for the plumbing and heating; electric wiring and installation of fixtures in connection with the construction of the new county asylum. J. W. McKay, architect. A. MacDougall, secretary of building commission, Pictou, N.S.

Port Elgin, Ont.—Tenders will be received until 12 o'clock noon, August 5th, by the department of public works, Ottawa, for repairs to breakwater. Plans, etc., at the office of the district engineer, Toronto, and at the post-office, Port Elgin, Ont. R. C. Desrochers, secretary.

St. John, N.B.—Contracts for supply of materials have been awarded by the city council as follows: valves, taps and boxes to Drummond McCall Co.; castings to James Fleming; cast-iron pipe to Vroom and Arnold; and lead pipe and leadite to James Roberston Co., Ltd.

St. John, N.B.—Contract has been awarded by the department of public works, Ottawa, for post office fittings, to John Flood and Sons, St. John, N.B. Contract price, $1,950. R. C. Desrochers, secretary.

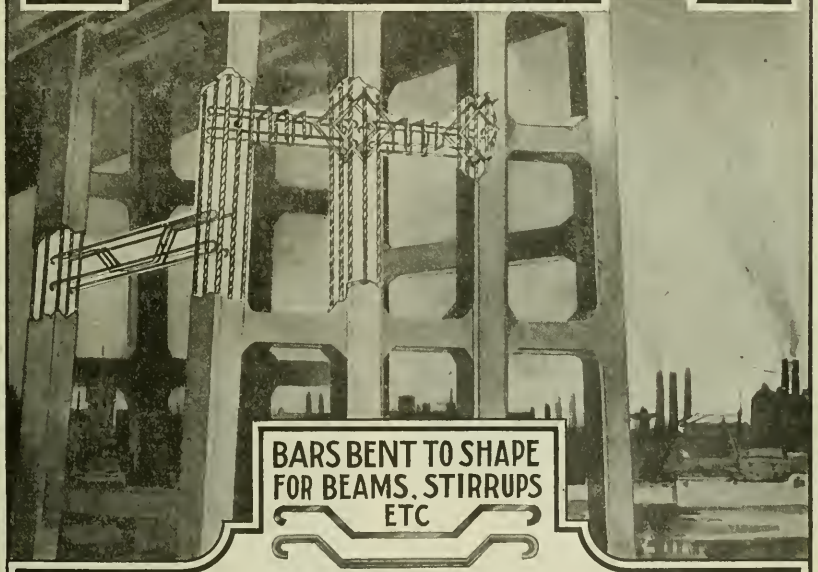
St. John, N.B.—Contracts have been awarded by the department of works for the following excavations: East St. John, to Moses and Tobias, of St. John, N.B. Rejected tender from Lewis and Thomas Stephen and the New Brunswick Contracting and Building Co., St. John. Brussels and King Sts., to Tobias and Farris; City Rd., Duke St. and Douglas Ave., to the New Brunswick Contracting and Building Co.; sewer excavation in Douglas Ave., to Lewis and Thomas Stephen. G. G. Hare, city engineer.

St. John, N.B.—The following tenders were received by the city council and referred to Commissioner Jones for report: St. John Iron Works.—Gate valves, 16-in. to 6-in., $160, $82, $36, $41, $28, $178.50, $91.35, $70.10, $46, $31.45. Special castings, 5 cents per lb. Union Foundry and Machine Works.—Special castings, 8 cents per lb.; service and curb boxes, $4.90 and $2.80, respectively. Hall Machinery Co., Sherbrooke, Que.—Cast iron pipe, $50 per ton. Special castings, 5¾ cents per lb.; both f.o.b. New Jersey, U.S.A. A. R. Williams Machinery Co.—Gate valves, $135, $62.40, $37.60, $22.40. T. McAvity and Sons, Ltd.—Five hydrants, $110 each. Gate valves, $165, $75, $54, $32.40, $19.50. Stop cocks, $3.05, $2.70, $1.45. Service boxes, $10.75. Lead pipe, 12½ cents per lb. Leadite, 16 cents per lb. Vroom and Arnold.—Cast iron pipe, $66.50 per ton; special castings, 7½ cents per lb. Drummond McCall, Montreal.—Market price at time of order. James Robertson and Co., Ltd.—Gate valves, $178.40, $89.26, $64.34, $36.87, $22.23; leadite, 15¾ cents per lb. Phœnix Foundry.—Gate valves, $170.85, $61.50, $35, $21.50; special castings, 7 cents per lb.; hydrants, $97.50; stop cock boxes, $5 each. Estey and Co.—Cast iron pipe, $57.25 per ton; fittings, $110 per ton. Canadian Fairbanks Morse, Ltd.—Gate valves, $201.80, $80, $57.60, $34.56, $20.80; fire hydrants, $87.48.

Toronto, Ont.—Contract has been awarded by the department of public works, Toronto, to the Dufferin Construction Co., Toronto, for the excavation work on Rouge Hill, county of Pickering. Excavation will be commenced about August 1st, and be completed this fall. W. A. McLean, deputy minister highway department.

Toronto, Ont.—Contract has been awarded by the Hydro-Electric Power Commission of Ontario to M. Beatty & Sons, Ltd., Welland, Ont., for two 80 h.p. triple drum electric hoists, two 80 h.p. double drum electric hoists, and four 10 h.p. triple-geared independent electric boom swingers. This

BURLINGTON STEEL CO LTD
HAMILTON



BARS BENT TO SHAPE FOR BEAMS, STIRRUPS ETC

STEEL BARS
FOR CONCRETE REINFORCEMENT
ROUNDS, SQUARES, TWISTED SQUARES, FLATS, ANGLES.

machinery is for use on the new power canal being built by the Commission in connection with the Chippewa-Queenston hydro-electric power development.

Toronto, Ont.—Tenders will be received until 12 o'clock noon, August 19th, by the department of public highways, Toronto, for the construction of concrete structures on the provincial highway from Cobourg to Port Hope. Plans, etc., at the office of the resident engineer, Port Hope, and at the department, Toronto. (Official advertisement in this issue.) W. A. McLean, deputy minister.

Toronto, Ont.—Tenders will be received until 12 o'clock noon, August 25th, by the Canadian National Railways, for 1,375,000 railway ties. Delivery to be on C.N. Ry. lines as follows:—1,000,000, Port Arthur to Pembroke; 50,000, Central Ontario; 25,000, Ottawa to Quebec; 200,000, O'Brien to Quebec; 100,000, Lake St. John district. E. Langham, general purchasing agent.

Toronto, Ont.—The board of control has authorized the Parks Commissioner to purchase additional park seats, cost $1,654, and one thousand chairs, cost $1,110, for use at Exhibition Park.

Township of Dover, Ont.—Tenders will be received until 6 p.m., August 2nd, for construction of a dash wheel, pump-house and concrete wheel-pit at Myers' Pumping Works. J. St. Pierre, Bear Line, Ont., R.R. No. 1.

Vancouver, B.C.—Contract has been awarded to the Sidney E. Junkins Co., Ltd., for construction of the concrete lining in the Connaught tunnel of the Canadian Pacific Ry.

Vancouver, B.C.—Tenders will be called until 12 o'clock noon, August 5th, for supply of a new 1,000-gallon gasoline pumping engine for the fire department. James Stuart, purchasing agent.

Victoria, B.C.—The D'Arcy Oil Co. have applied to the provincial government for permission to prospect for oil. If successful, a pipe line would be laid from the Peace River to the coast. Estimated cost, $25,000,000.

Windsor, Ont.—The city council contemplate buying two motor truck street flushers. Estimated cost, $20,000. M. A. Dickenson, acting clerk.

Winnipeg, Man.—Tenders will be received by the Greater Winnipeg Water District until noon, September 1st, for apparatus which will indicate at the head office of the District the water level in the District's surge tank at St. Boniface. R. D. Waugh, chairman of commissioners, 501 Tribune Building, Winnipeg.

ADDITIONAL TENDERS PENDING

Not Including Those Reported in This Issue

Further information may be had from the issues of *The Canadian Engineer*, to which reference is made.

PLACE OF WORK	TENDERS CLOSE	ISSUE OF	PAGE
Chicoutimi, Que., station	Aug. 9.	July 24.	46
Grosse Isle, Que., wharf	Aug. 5.	July 17.	52
Grosse Isle, Que., wharf	Aug. 5.	July 24.	48
Markham, Ont., concrete bridges	Aug. 2.	July 24.	42
Montreal, Que., office building	Aug. 4.	July 24.	46
Newmarket, Ont., sewers	Aug. 7.	July 24.	42
North Bay, Ont., sewers	Aug. 2.	July 24.	42
Okanagan Centre, B.C., wharf	Aug. 5.	July 24.	48
Petrolea, Ont., nurses' home	Aug. 7.	July 24.	46
Port Elgin, Ont., wharf and breakwater	Aug. 5.	July 24.	50
Saskatoon, Sask., turbo-generator	Sept. 23.	July 24.	44
Shippigan Gully, N.B., breakwater	Aug. 5.	July 24.	50
Sutherland Sask., lighting plant, etc.	Aug. 5.	July 24.	44
Toronto, Ont., railway buildings	Aug. 1.	July 24.	48
York Township, Ont., water mains	Aug. 5.	July 17.	45

Tenders Called For

TENDERS FOR BRIDGES

Sealed tenders, plainly marked as to contents, addressed to the undersigned, will be received up to 2 p.m. on Monday, August the 11th, 1919, for the construction of the following reinforced cement concrete culverts, bridges and abutments:—

(1) Located in the County of Dufferin—
1 culvert 4-foot span.
4 culverts 6-foot "
1 culvert 8-foot "
7 bridges 10-foot "
2 bridges 12-foot "
1 bridge 14-foot "
1 bridge 16-foot "
1 bridge 20-foot "
1 bridge 22-foot "
3 bridges 24-foot "

(2) Located in the Township of Albion—
1 pair of abutments for a 55-foot steel truss.
1 " " " " " 48-foot " "

(3) Located in the Township of Toronto Gore—
1 bridge 32-foot span.

(4) Located in the Township of Toronto—
1 bridge 12-foot span.

Plans and specifications may be seen and forms of tender and all information obtained at the office of the undersigned.

The lowest or any tender not necessarily accepted.

WHEELOCK & CHRISTIE,
Civil Engineers,
Orangeville, Ont. 314

TOWNSHIP OF YORK

TENDERS FOR CONCRETE SIDEWALKS

Sealed tenders, plainly marked as to contents, will be received by the undersigned up to 10 o'clock of Tuesday, August 5th, 1919, for the construction of concrete sidewalks on Westwood and Hillbrow Avenues, in the Township of York.

Plans and specifications may be seen at the office of the undersigned, 40 Jarvis St., Toronto.

The lowest or any tender will not necessarily be accepted.

FRANK BARBER,
Township Engineer.
Toronto, July 23rd, 1919. 312

NOTICE TO CONTRACTORS

Sealed tenders, marked "Tenders for Concrete Structures," will be received by the undersigned until 12 o'clock noon on Tuesday, August the 19th, 1919, for the construction of the concrete structures on the Provincial Highway from Cobourg to Port Hope.

Plans, specifications and forms of tender may be seen on and after Tuesday, August the 5th, 1919, at the Office of the Resident Engineer, Port Hope, and at the Office of the undersigned.

A marked cheque for Five Hundred Dollars, payable to the Minister of Public Works and Highways, Ontario, must accompany each tender.

The lowest or any tender not necessarily accepted.

W. A. McLEAN,
Deputy Minister of Highways.
Department of Public Highways,
Toronto, July the 29th, 1919. 315

The Canadian Engineer

A Weekly Paper for Civil Engineers and Contractors

Riveted Joints for Steel Penstocks and Tanks

Formulae and Tables for Their Design—Selection of Proper Type of Joint—Examples of Solution for Maximum Joint Efficiency — Discussion of the Heavier Types, Including Triple, Quadruple and Quintuple Riveted Butt and Double Strap Joints

By H. A. BABCOCK and J. R. MONTAGUE
Hydraulic Engineering Department, Hydro-Electric Power Commission of Ontario

IN this paper the writers have endeavored to outline in a clear and practical way the essential points in connection with the choice and design of riveted joints in steel plate cylinders.

Very little is to be found in engineering texts on the design of the heavier type of riveted joints, that is the triple, quadruple and quintuple riveted butt and double strap joints. It is therefore hoped that the section of this paper covering that portion of the work may be of considerable interest to designers.

The selection of the proper type of joint to be used in any particular case, will first be discussed, followed by the method of design, numerical examples, and tables giving the dimensions recommended by the Hartford Steam Boiler Inspection & Insurance Co. for the various types of joints.

Nomenclature

e = Efficiency of joint, expressed in decimals.
f = Tensile strength of plate, in pounds per square inch.

FIG. 1—EUGENIA FALLS PENSTOCK, 54-INS. DIAMETER, WITH TRIPLE-RIVETED BUTT JOINT ON LONGITUDINAL SEAM AND DOUBLE-RIVETED LAP ON GIRTH SEAM

t = Plate thickness, in inches.
b = Butt strap thickness, in inches.
P = Pitch of rivets, in inches, in row having greatest pitch.
d = Rivet diameter after driving, in inches.
D = Internal diameter of cylinder, in inches.
a = Cross-sectional area of rivet after driving, in square inches.
s = Ultimate strength of rivets in single shear, in pounds per square inch.
S = Ultimate strength of rivets in double shear, in pounds per square inch.
p = Internal pressure, in pounds per square inch.

Selecting Proper Type of Joint

Where the thickness of the plate is dependent upon factors other than the internal pressure, such as rigidity of the section against collapsing, the type of joint depends

FIG. 2—DOUBLE-RIVETED LAP JOINT IN 18-FT. DIAMETER PIPE, ONTARIO POWER CO.

largely on the effiiciency required. To determine the efficiency, the following formula may be used:—

$$e = pD\ 2ft.$$

Having thus determined the efficiency, and knowing the thickness of plate, the proper type of joint can be selected from the accompanying standard charts, or it can be designed by the methods given in the latter part of this paper.

Where the plate thickness is governed by internal pressure, for a pipe of given diameter, the problem resolves itself into one of choosing that type of joint which will give the most economical pipe section. This is not always accomplished by using the most efficient joint, as will be pointed out later.

Riveted Lap Joints

On girth seams, the single riveted lap joints are sometimes used, particularly in the case of small diameter pipes, but are not to be recommended for pipes over 5 ft. in diameter.

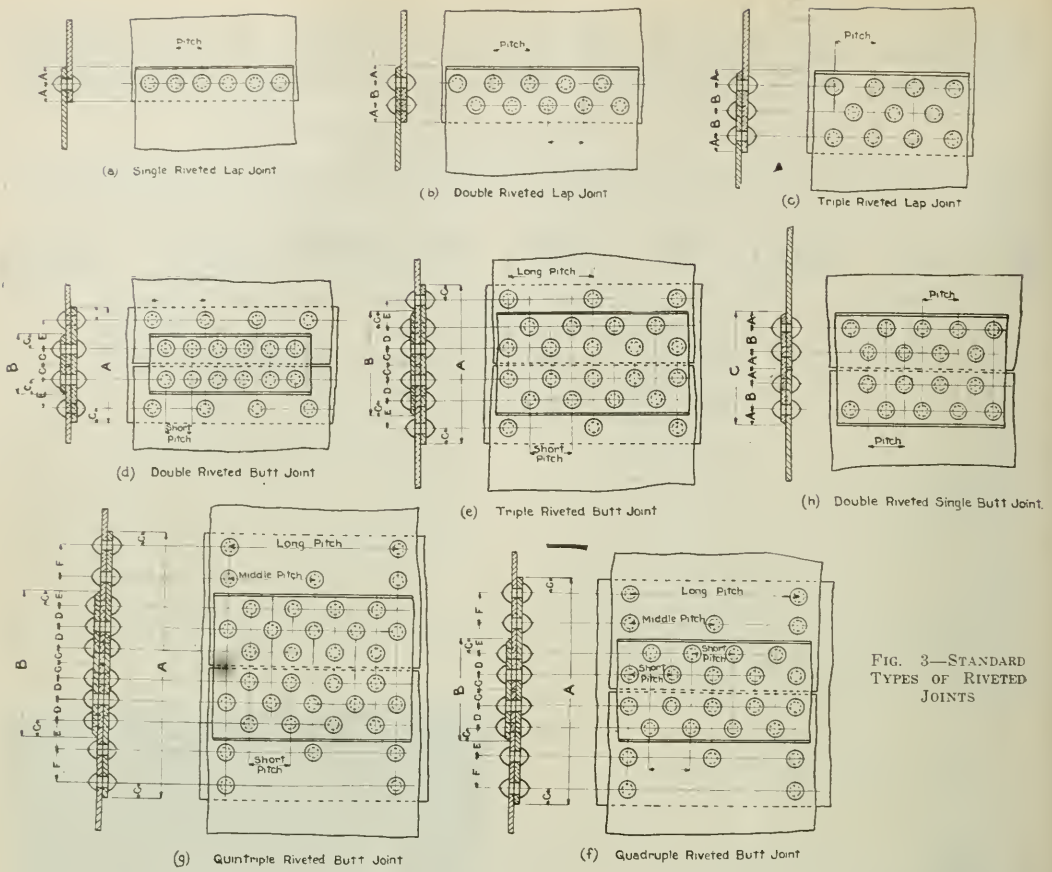

Pitch
(a) Single Riveted Lap Joint
(b) Double Riveted Lap Joint
(c) Triple Riveted Lap Joint
Long Pitch
Short Pitch
(d) Double Riveted Butt Joint
(e) Triple Riveted Butt Joint
(h) Double Riveted Single Butt Joint.
Middle Pitch
(g) Quintriple Riveted Butt Joint
(f) Quadruple Riveted Butt Joint

FIG. 3—STANDARD TYPES OF RIVETED JOINTS

They are seldom used in longitudinal seams unless the pressure is very light and the pipe diameter small. Under high presures there is a tendency for the joint to buckle, as shown in Fig 6. It is apparent that such a tendency is very undesirable as far as watertightness is concerned. Single riveted lap joints are used almost exclusively in spiral riveted pipe, in which case they are satisfactory.

Double riveted lap joints are used very largely in girth seams, especially in large diameter pipes. Their use in longitudinal seams is quite satisfactory for pipes up to 8 ft. in diameter where they fulfill the requirements of efficiency and rigidity of section. When propertly caulked, they can be made entirely watertight. In girth seams, they are usually designed with the same diameter of rivet as is used in the adjacent longitudinal seams, for the sake of simplicity.

Triple riveted lap joints are far more satisfactory in longitudinal seams than either single or double riveted lap joints, because of their greater rigidity and consequent watertightness. For pipe diameters greater than 4 ft., they are uneconomical except where the required joint efficiency is not more than 75%.

FIG. 4—PENSTOCK, 10-FT. DIAMETER, WITH SINGLE-RIVETED LAP JOINTS (AT HANNAWA FALLS, N.Y.)

It should be borne in mind that in no case should a lap joint be used for joining plates more than ½ in. in thickness, except in the case of circumferential joints.

Riveted Butt and Double Strap Joints

Double riveted butt joints are especially recommended for longitudinal seams where joint efficiency is not a prime factor, but where watertightness is essential. This is evident from the fact that the narrow strap has a well supported caulking edge, the pitch of rivets in the second row being much less than in either the double or triple riveted lap joints, as can be seen from the accompanying tables. In all butt strap joints, the narrow strap should be placed on the outside of the pipe. While both straps may be caulked, the narrow strap is the principal one in making the joint water tight, and must be accessible for recaulking in case a leak develops in testing.

Triple riveted butt joints are used in longitudinal seams where the required efficiency cannot be satisfied by any of the simpler joints; or they should be used in the smaller diameter pipes where the increased cost of a quadruple riveted butt joint is more than the saving in the metal effected by its higher efficiency.

TABLE 1—SINGLE RIVETED LAP JOINTS*

Thickness of Plate	Diameter of Rivet Holes	Efficiency %	Pitch	A	Method of Failure
¼"	11/16"	60.7	1¾"	1 1/16"	T.P.
9/32"	11/16"	60.3	1¾"	1 1/16"	S.R.
5/16"	13/16"	59.4	2"	1¼"	T.P.
11/32"	13/16"	59.4	2"	1¼"	T.P.
3/8"	15/16"	58.3	2¼"	1 7/16"	T.P.
13/32"	15/16"	58.3	2¼"	1 7/16"	T.P.
7/16"	1 1/16"	57.5	2½"	1⅝"	T.P.
15/32"	1 1/16"	57.5	2½"	1⅝"	T.P.
½"	1 1/16"	56.7	2½"	1⅝"	S.R.

*Joint efficiencies in Tables 1 to 6 are computed upon the following basis:—Tensile strength of plate = 55,000 lbs. per sq. in.; resistance to crushing of plate = 95,000 lbs. per sq. in.; strength of rivets in single shear = 44,000 lbs. per sq. in. In the columns headed "Method of Failure," T.P. indicates that the joint will fail by tearing the plate in the net section between rivet holes, and S.R. means that the failure will be due to shearing of rivets.

TABLE 2—DOUBLE RIVETED LAP JOINTS

Thickness of Plate	Diameter of Rivet Holes	Efficiency %	Pitch	A	B	Method of Failure
¼"	11/16"	69.5	2¼"	1 1/16"	1¾"	T.P.
9/32"	11/16"	69.5	2¼"	1 1/16"	1¾"	T.P.
5/16"	13/16"	69.1	2⅝"	1¼"	1⅞"	T.P.
11/32"	13/16"	69.1	2⅝"	1¼"	1⅞"	T.P.
3/8"	15/16"	68.9	3"	1 7/16"	2"	T.P.
13/32"	15/16"	68.9	3"	1 7/16"	2"	T.P.
7/16" ....1 1/16"		68.5	3⅜"	1⅝"	2⅛"	T.P.
15/32" ....1 1/16"		68.5	3⅜"	1⅝"	2⅛"	T.P.
½" ....1 1/16"		68.5	3⅜"	1⅝"	2⅛"	T.P.

Quadruple riveted butt joints are used where maximum efficiency is required in the longitudinal seams of pipes having a diameter of 4½ ft. or more. For smaller diameters, it would be advisable to compute the cost of pipe per foot of length for both quadruple and triple riveted butt joints, and for very small diameters it would be well to consider also the double riveted butt joint.

Occasionally resort is made to quintuple riveted butt joints where a very high efficiency is essential, due to a necessary limit to the thickness of plate used, but on account of higher cost and increased resistance to the flow of water, their use in pipe should be avoided if possible. They may be found economical for use in the joints of tanks and standpipes, where friction is a negligible factor.

Another type of joint coming into more general use, especially for girth seams, is the single strap double riveted butt joint. The strap is made the same thickness as the main plates, and its mathematical treatment is the same as that of a double riveted lap joint. Its particular advantages lie in the smooth surface it presents on the inside of the pipe and, in girth seams, in the use of pipe sections having constant diameter.

Joint Efficiency Principal Consideration

The principal consideration entering into the design of a riveted joint is the determination of joint efficiency. Joint efficiency may be defined as the ratio of the strength of the joint to the strength of the uncut plate, and is usually expressed in percentage. The following formulæ may be used to determine the efficiency of the different types of joints:—

FIG. 5—BIG CHUTE PENSTOCK, 9-FT. DIAMETER, WITH SINGLE AND DOUBLE-RIVETED LAP JOINTS

Formulæ for Riveted Lap Joints

A = Strength of solid plate.
= Ptf.
B = Strength of plate between rivet holes.
= $(P-d)tf$.
C = Shearing strength of one rivet in single shear for single-riveted, of two rivets in single shear for double-riveted, or of three rivets in single shear for triple-riveted.
= nsa.
D = Crushing strength of plate in front of one rivet for single-riveted, of two rivets for double-riveted, or of three rivets for triple-riveted.
= $ndtc$.

To obtain the joint efficiency, divide B, C or D, whichever is the least, by A.

Formulæ for Riveted Butt and Double Strap Joints

A = Strength of solid plate.
= Ptf.
B = Strength of plate between rivet holes in the outer row.
= $(P-d)tf$.
C = Shearing strength of two rivets in double shear for double-riveted, of four rivets in double shear for triple-riveted, or of eight rivets in double shear for quadruple-riveted, plus the shearing strength of one rivet in single shear for double and triple riveted and three rivets in single shear for quadruple riveted.
= $NSa+nsa$.
D = Strength of plate between rivet holes in the second row, plus the shearing strength of one rivet in single shear in the outer row.
= $(P-2d)tf+nsa$.

E = Strength of plate between rivet holes in the second row, plus the crushing strength of butt strap in front of one rivet in the outer row.
= $(P-2d)tf+dbc$.

F = Crushing strength of plate in front of two rivets for double-riveted, of four rivets for triple-riveted, or of eight rivets for quadruple-riveted, plus the crushing strength of butt strap in front of one rivet for double-riveted, of one rivet for triple-riveted, or of three rivets for quadruple-riveted.
= $Ndtc+ndbc$.

G = Crushing strength of plate in front of two rivets for double-riveted, of four rivets for triple-riveted, or of eight rivets for quadruple-riveted, plus the shearing strength of one rivet in single shear for double-riveted, of one rivet in single shear for triple-riveted, or of three rivets in single shear for quadruple-riveted.
= $Ndtc+nsa$.

H = Strength† of plate between rivet holes in the third row, plus the shearing strength of two rivets in the second row in single shear and one rivet in single shear in the outer row.
= $(P-4d)tf+nsa$.

I = Strength† of plate between rivet holes in the third row, plus the crushing strength of butt strap in front of two rivets in the second row and one rivet in the outer row.
= $(P-4d)tf+ndbc$.

To obtain the joint efficiency, divide A, B, C, D, E, F, G, H or I, whichever is the least, by A.

The first step in the design of a riveted joint for a given thickness of plate is to assume a rivet diameter within the limits given in Table 8, and with this diameter, various values for the pitch of rivets, within the limits described below, should be tried out until that pitch which gives a maximum joint efficiency is obtained. Having determined the proper pitch for a given rivet diameter, the same process should be repeated using various rivet diameters until that combination of pitch and rivet diameter which will give the maximum efficiency, is obtained. A fairly broad range of rivet diameters may be used, the limits for a given plate thickness being shown in Table 8.

TABLE 3—TRIPLE RIVETED LAP JOINTS

Thickness of Plate	Diameter of Rivet Holes	Efficiency %	Pitch	A	B
3/8"	13/16"	75	3 1/4"	1 1/4"	2 1/8"
7/16"	15/16"	75	3 3/4"	1 7/16"	2 3/8"
1/2"	15/16"	75	3 3/4"	1 7/16"	2 3/8"

Pitch of Rivets

The maximum pitch of rivets is controlled by the limits for caulking along the joint having shortest pitch (see Fig. 3). It is evident that if the pitch (or short pitch in the case of butt joints) is very great in proportion to the thickness of the plate or butt strap, there will be a tendency for the plates to spring apart between rivets. This maximum distance is one which is difficult if not impossible to determine analytically, but which has been found in practice to conform very closely to values given in Tables 1 to 6. In the case of lap joints, the maximum pitch for various combinations of plate thickness and rivet diameter is given in Table 7. For butt strap joints, the values for short pitch given in Tables 4 to 6 should not be exceeded except according to the following rules:—

Rule 1.—The short pitch *may* be increased by 1½ times any increase in rivet diameter plus 1½ times any increase in butt strap thickness.

Rule 2.—Should either the rivet diameter or butt strap thickness be decreased below the values given in Tables 4 to 6, the short pitch *must* be decreased by 1½ times the change in rivet diameter plus 1½ times the change in butt strap thickness.

The minimum pitch of rivets for either lap or butt strap joints can be obtained from Fig. 3 for various distances between gauge lines, and vice versa. The distances between gauge lines given in Fig. 7, while not rigidly adhered to in all cases, are based on the recommended minimum distance between rivets for good shop practice. To go below this minimum distance may mean the use of special rivet dies for driving the rivets, for quadruple or quintuple riveted butt joints, tance between gauge lines is usually made greater than the allowable minimum, for convenience in assembling and riveting the joints.

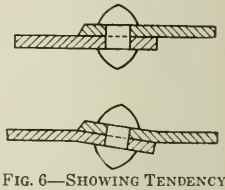


FIG. 6—SHOWING TENDENCY OF SINGLE-RIVETED LAP JOINT TO BUCKLE OR TWIST

On butt strap joints the dimension E is determined by adding to dimension C one-half the diameter of a standard rivet die for the particular size of rivet used, plus 1/16 in. for clearance.

Expressing this as a formula:—

$E = C + (\frac{1}{2}\text{diameter of rivet die}) + \frac{1}{16}$ in.

The dimension F between the first and second rows of rivets, for quadruple or quintuple riveted butt joints, should not be less than that given in Table 6, for given rivet diameters and butt strap thicknesses.

TABLE 4—DOUBLE RIVETED BUTT JOINTS*

Thickness of Plate	Thickness of Strap	Diameter of Rivet Hole	Efficiency %	Long Pitch	Short Pitch	A	B	C	E
1/4"	1/4"	11/16"	82.8	4"	2"	8 1/2"	4 1/4"	1 1/16"	2 1/8"
9/32"	1/4"	11/16"	82.8	4"	2"	8 1/2"	4 1/4"	1 1/16"	2 1/8"
5/16"	9/32"	13/16"	81.9	4 1/2"	2 1/4"	9 7/8"	5"	1 1/4"	2 7/16"
11/32"	9/32"	13/16"	81.9	4 1/2"	2 1/4"	9 7/8"	5"	1 1/4"	2 7/16"
3/8"	5/16"	13/16"	81.9	4 1/2"	2 1/4"	9 7/8"	5"	1 1/4"	2 7/16"
13/32"	5/16"	13/16"	81.9	4 1/2"	2 1/4"	9 7/8"	5"	1 1/4"	2 7/16"
7/16"	3/8"	15/16"	81.3	5"	2 1/2"	11 1/4"	5 3/4"	1 7/16"	2 3/4"
15/32"	3/8"	15/16"	81.3	5"	2 1/2"	11 1/4"	5 3/4"	1 7/16"	2 3/4"
1/2"	7/16"	15/16"	81.3	5"	2 1/2"	11 1/4"	5 3/4"	1 7/16"	2 3/4"

*All joints in above table fail by tearing the plate between rivet holes in the outer row. For convenience in driving rivets, the back-pitch (dimension E) may be increased if desired without affecting the joint efficiency, but it should not be decreased.

Thickness of Butt Strap

The thickness of butt strap should be chosen so that the net section along the inner row of rivets has sufficient area to take in tension the total force carried by the joint. The formula.

$$b = [P/2(P-nd)]te,$$

where n = number of rivets in distance P on inner row, will give the required thickness of each butt strap.

General Remarks

The dimensions for riveted joints given in Tables 1 to 6, both inclusive, are those recommended by the Hartford Steam Boiler Inspection & Insurance Co., and are computed upon the following basis:—

Tensile strength of plate = 55,000 lbs. per sq. in.
Resistance to crushing of plate = 95,000 lbs. per sq. in.
Strength of rivets in single shear = 44,000 lbs. per sq. in.
Strength of rivets in double shear = 88,000 lbs. per sq. in.

In cases where different stresses are used, the efficiency may vary accordingly, and should be computed for the new condition. The dimensions for pitch and spacing between rows of rivets are based on well-recognized standards and should be adhered to as closely as possible.

The formulæ for obtaining joint efficiency are based

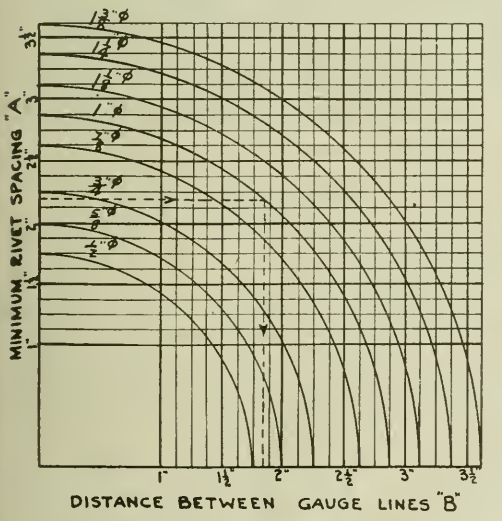
†For quadruple-riveted and quintuple-riveted butt and double strap joints only.

TABLE 5—TRIPLE RIVETED BUTT JOINTS*

Thickness of Plate	Thickness of Straps	Diameter of Rivet Holes	Efficiency %	Long Pitch	Short Pitch	A	B	C	D	E
1/4"	1/4"	11/16"	87.5	5 1/2"	2 3/4"	12"	7 3/4"	1 1/16"	1 3/4"	2 1/8"
9/32"	1/4"	11/16"	87.5	5 1/2"	2 3/4"	12"	7 3/4"	1 1/16"	1 3/4"	2 1/8"
5/16"	9/32"	13/16"	87.5	6 1/2"	3 1/4"	13 5/8"	8 3/4"	1 1/4"	1 7/8"	2 7/16"
11/32"	9/32"	13/16"	87.5	6 1/2"	3 1/4"	13 5/8"	8 3/4"	1 1/4"	1 7/8"	2 7/16"
3/8"	5/16"	13/16"	88.4	7"	3 1/2"	13 5/8"	8 3/4"	1 1/4"	1 7/8"	2 7/16"
13/32"	5/16"	13/16"	88.4	7"	3 1/2"	13 5/8"	8 3/4"	1 1/4"	1 7/8"	2 7/16"
7/16"	3/8"	15/16"	87.9	7 3/4"	3 7/8"	15 1/4"	9 3/4"	1 7/16"	2"	2 3/4"
15/32"	3/8"	15/16"	87.9	7 3/4"	3 7/8"	15 1/4"	9 3/4"	1 7/16"	2"	2 3/4"
1/2"	7/16"	15/16"	88.3	8"	4"	15 1/4"	9 3/4"	1 7/16"	2"	2 3/4"
17/32"	7/16"	15/16"	88.3	8"	4"	15 1/4"	9 3/4"	1 7/16"	2"	2 3/4"
9/16"	7/16"	11/16"	86.7	8"	4"	17"	11"	1 5/8"	2 1/4"	3"
19/32"	1/2"	11/16"	86.7	8"	4"	17"	11"	1 5/8"	2 1/4"	3"
5/8"	1/2"	11/16"	86.7	8"	4"	17"	11"	1 5/8"	2 1/4"	3"
21/32"	1/2"	11/16"	86.7	8"	4"	17"	11"	1 5/8"	2 1/4"	3"
11/16"	1/2"	13/16"	85.6	8 1/4"	4 1/8"	18 1/2"	12"	1 13/16"	2 3/8"	3 1/4"
23/32"	1/2"	13/16"	85.6	8 1/4"	4 1/8"	18 1/2"	12"	1 13/16"	2 3/8"	3 1/4"
3/4"	1/2"	13/16"	85.5	8 1/4"	4 1/8"	18 1/2"	12"	1 13/16"	2 3/8"	3 1/4"
25/32"	9/16"	15/16"	84.6	8 1/2"	4 1/4"	20 1/4"	13 1/4"	2"	2 5/8"	3 1/2"
13/16"	9/16"	15/16"	84.6	8 1/2"	4 1/4"	20 1/4"	13 1/4"	2"	2 5/8"	3 1/2"
27/32"	9/16"	15/16"	84.2	8 1/2"	4 1/4"	20 1/4"	13 1/4"	2"	2 5/8"	3 1/2"
7/8"	5/8"	15/16"	84.1	8 3/4"	4 3/8"	20 1/4"	13 1/4"	2"	2 5/8"	3 1/2"
29/32"	5/8"	15/16"	83.6	8 3/4"	4 3/8"	20 1/4"	13 1/4"	2"	2 5/8"	3 1/2"
15/16"	11/16"	15/16"	83.7	9"	4 1/2"	20 1/4"	13 1/4"	2"	2 5/8"	3 1/2"
31/32"	11/16"	15/16"	83.2	9"	4 1/2"	20 1/4"	13 1/4"	2"	2 5/8"	3 1/2"
1"	3/4"	17/16"	83.4	9 1/2"	4 3/4"	22"	14 1/2"	2 3/16"	2 7/8"	3 3/4"

*Joints for plate thickness from 27/32" to 1" (both inclusive) fail by tearing the plate between rivet holes in the second row and shearing a rivet in the outer row. This also applies to the joint for the 3/4" plate. All other joints in the above table fail by tearing the plate between rivet holes in the outer row. For convenience in driving rivets, either of the dimensions for back-pitch (D and E) may be increased without affecting the joint efficiency, but not decreased.

Diam Riv. ins	1/2"	5/8"	3/4"	7/8"	1"	1 1/8"	1 1/4"	1 3/8"
Min. Spcg. ins	1 3/4"	2"	2 1/4"	2 5/8"	2 7/8"	3 1/8"	3 3/8"	3 5/8"



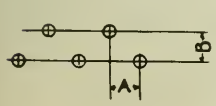


FIG. 7—CURVES FOR MINIMUM RIVET SPACING AND DISTANCES BETWEEN PARALLEL ROWS OF STAGGERED RIVETS

on the rules formulated by the Massachusetts Board of Boiler Rules.

Numerical Examples

Design of a triple-riveted lap joint for a 7/16-in. plate.

From Table 8, the sizes of rivets that may be used in 7/16-in. plates range from 5/8-in. to 1 1/4-ins.

FIG. 8—ONTARIO POWER CO.'S TANK, 60-FT. DIAMETER, WITH QUADRUPLE-RIVETED BUTT JOINTS ON LONGITUDINAL SEAMS AND SINGLE-RIVETED LAP ON GIRTH SEAMS

First trial: Assume the same size and pitch of rivets as shown in Table 3, that is 7/8 in. diameter and a pitch of 3 3/4 ins. Then

t = 7/16 in. = 0.4375 in.
P = 3 3/4 ins. = 3.75 ins.
d = 15/16 in. = 0.9375 in.
a = 0.6903 sq. in.
f = 55,000 lbs. per sq. in.
s = 44,000 lbs. per sq. in.
c = 95,000 lbs. per sq. in.

From the formulae for determining the efficiency of lap joints, we have:—

TABLE 6—QUADRUPLE RIVETED BUTT JOINTS*

Thickness of Plate	Thickness of Strap	Diameter of Rivet Hole	Efficiency %	Long Pitch	Middle Pitch	Short Pitch	A	B	C	D	E	F
1/4"	1/4"	11/16"	93.8	11"	5 1/2"	2 3/4"	16 1/2"	7 3/4"	1 1/16"	1 3/4"	2 1/8"	2 1/4"
9/32"	1/4"	11/16"	93.8	11"	5 1/2"	2 3/4"	16 1/2"	7 3/4"	1 1/16"	1 3/4"	2 1/8"	2 1/4"
5/16"	9/32"	13/16"	93.8	13"	6 1/2"	3 1/4"	18 7/8"	8 3/4"	1 1/4"	1 7/8"	2 7/16"	2 5/8"
11/32"	9/32"	13/16"	93.8	13"	6 1/2"	3 1/4"	18 7/8"	8 3/4"	1 1/4"	1 7/8"	2 7/16"	2 5/8"
3/8"	5/16"	13/16"	94.2	14"	7"	3 1/2"	19 1/8"	8 3/4"	1 1/4"	1 7/8"	2 7/16"	2 3/4"
13/32"	5/16"	13/16"	94.2	14"	7"	3 1/2"	19 1/8"	8 3/4"	1 1/4"	1 7/8"	2 7/16"	2 3/4"
7/16"	3/8"	15/16"	94.0	15 1/2"	7 3/4"	3 7/8"	21 3/8"	9 3/4"	1 7/16"	2"	2 3/4"	3 1/16"
15/32"	3/8"	15/16"	94.0	15 1/2"	7 3/4"	3 7/8"	21 3/8"	9 3/4"	1 7/16"	2"	2 3/4"	3 1/16"
1/2"	7/16"	15/16"	94.1	16"	8"	4"	21 1/2"	9 3/4"	1 7/16"	2"	2 3/4"	3 1/8"
17/32"	7/16"	15/16"	94.1	16"	8"	4"	21 1/2"	9 3/4"	1 7/16"	2"	2 3/4"	3 1/8"
9/16"	7/16"	15/16"	94.1	16"	8"	4"	21 1/2"	9 3/4"	1 7/16"	2"	2 3/4"	3 1/8"
9/16"	7/16"	11/16"	93.4	16"	8"	4"	23 5/8"	11"	1 5/8"	2 1/4"	3"	3 5/16"
19/32"	1/2"	11/16"	93.4	16"	8"	4"	23 5/8"	11"	1 5/8"	2 1/4"	3"	3 5/16"
5/8"	1/2"	11/16"	93.4	16"	8"	4"	23 5/8"	11"	1 5/8"	2 1/4"	3"	3 5/16"
21/32"	1/2"	11/16"	93.4	16"	8"	4"	23 5/8"	11"	1 5/8"	2 1/4"	3"	3 5/16"
11/16"	1/2"	13/16"	92.8	16 1/2"	8 1/4"	4 1/8"	25 5/8"	12"	1 13/16"	2 3/8"	3 1/4"	3 9/16"
23/32"	1/2"	13/16"	92.8	16 1/2"	8 1/4"	4 1/8"	25 5/8"	12"	1 13/16"	2 3/8"	3 1/4"	3 9/16"
3/4"	1/2"	13/16"	92.7	16 1/2"	8 1/4"	4 1/8"	25 5/8"	12"	1 13/16"	2 3/8"	3 1/4"	3 9/16"
25/32"	9/16"	15/16"	92.3	17"	8 1/2"	4 1/4"	27 7/8"	13 1/4"	2"	2 5/8"	3 1/2"	3 13/16"
13/16"	9/16"	15/16"	92.3	17"	8 1/2"	4 1/4"	27 7/8"	13 1/4"	2"	2 5/8"	3 1/2"	3 13/16"
27/32"	9/16"	15/16"	91.8	17"	8 1/2"	4 1/4"	27 7/8"	13 1/4"	2"	2 5/8"	3 1/2"	3 13/16"
7/8"	5/8"	15/16"	91.2	17 1/2"	8 3/4"	4 3/8"	28"	13 1/4"	2"	2 5/8"	3 1/2"	3 7/8"
29/32"	5/8"	15/16"	90.5	17 1/2"	8 3/4"	4 3/8"	28"	13 1/4"	2"	2 5/8"	3 1/2"	3 7/8"
15/16"	11/16"	15/16"	90.1	18"	9"	4 1/2"	28 1/8"	13 1/4"	2"	2 5/8"	3 1/2"	3 15/16"
31/32"	11/16"	15/16"	89.5	18"	9"	4 1/2"	28 1/8"	13 1/4"	2"	2 5/8"	3 1/2"	3 15/16"
1"	3/4"	17/16"	90.2	19"	9 1/2"	4 3/4"	30 1/2"	14 1/2"	2 3/16"	2 7/8"	3 3/4"	4 1/4"
1 1/32"	3/4"	17/16"	89.6	19"	9 1/2"	4 3/4"	30 1/2"	14 1/2"	2 3/16"	2 7/8"	3 3/4"	4 1/4"
1 1/16"	3/4"	17/16"	89.0	19"	9 1/2"	4 3/4"	30 1/2"	14 1/2"	2 3/16"	2 7/8"	3 3/4"	4 1/4"
1 3/32"	3/4"	17/16"	88.5	19"	9 1/2"	4 3/4"	30 1/2"	14 1/2"	2 3/16"	2 7/8"	3 3/4"	4 1/4"
1 1/8"	3/4"	17/16"	88.0	19"	9 1/2"	4 3/4"	30 1/2"	14 1/2"	2 3/16"	2 7/8"	3 3/4"	4 1/4"
1 5/32"	3/4"	17/16"	87.5	19"	9 1/2"	4 3/4"	30 1/2"	14 1/2"	2 3/16"	2 7/8"	3 3/4"	4 1/4"
1 3/16"	13/16"	17/16"	87.7	20"	10"	5"	30 5/8"	14 1/2"	2 3/16"	2 7/8"	3 3/4"	4 5/16"
1 7/16"	13/16"	17/16"	87.2	20"	10"	5"	30 5/8"	14 1/2"	2 3/16"	2 7/8"	3 3/4"	4 5/16"
1 1/4"	7/8"	17/16"	86.8	20"	10"	5"	30 5/8"	14 1/2"	2 3/16"	2 7/8"	3 3/4"	4 5/16"

*Joints for plate thickness from 27/32" to 1 1/4" (both inclusive) fail by tearing the plate between rivet holes in the third row and shearing the rivets in the outer two rows. This also applies to the joint for 3/4" plate. All other joints in the above table fail by tearing the plate between rivet holes in the outer row. For convenience in driving rivets, any of the dimensions for back-pitch (dimensions D, E and F) may be increased, if desired, without affecting the joint efficiency, but they should not be decreased.

$A = Ptf = 3.75 \times 0.4375 \times 55{,}000 = 90{,}234.$
$B = (P-d)tf =$
$(3.75-0.9375) \times 0.4375 \times 55{,}000 = 67{,}677.$
$C = nsa = 3 \times 44{,}000 \times 0.6903 = 99{,}120.$
$D = ndtc = 3 \times 0.9375 \times 0.4375 \times 95{,}000 = 116{,}689.$
$e = B/A = 0.75 = 75\%.$

Second trial: Assume the same diameter of rivet and a pitch of 3⅝ ins. Then $P = 3.625$ ins., and
$A = Ptf = 3.625 \times 0.4375 \times 55{,}000 = 87.338.$
$B = (P-d)tf =$
$(3.625-0.9375) \times 0.4375 \times 55{,}000 = 64{,}669.$
$C = nsa = 3 \times 44{,}000 \times 0.6903 = 99{,}120.$
$D = ndtc = 3 \times 0.875 \times 0.4375 \times 95{,}000 = 109{,}102.$
$e = B/A = 0.74 = 74\%.$

Third trial: Assume the same diameter of rivet and a pitch of 3⅞ ins. Then $P = 3.875$ ins., and
$A = Ptf = 3.875 \times 0.4375 \times 55{,}000 = 93{,}242.$
$B = (P-d)tf =$
$(3.875-0.9375) \times 0.4375 \times 55{,}000 = 70{,}684.$
$C = nsa = 3 \times 44{,}000 \times 0.6903 = 91{,}120.$
$D = ndtc = 3 \times 0.875 \times 0.4375 \times 95{,}000 = 109{,}112.$
$e = B/A = 0.758 = 75.8\%.$

From the above, it is seen that by increasing the pitch of the rivets, an increase in the efficiency of the joint is obtained. However, the pitch of the rivets is limited to that which will permit water-tight caulking. In this case the pitch should not exceed 3¾ ins. (see Table 7), and hence the maximum efficiency attainable with a ⅞-in. rivet is 75%.

The process should be repeated, using different sizes of rivets and various pitches. That combination of rivet diameter and pitch that gives the greatest efficiency, and does not exceed the maximum rivet spacing prescribed in Table 7, is the most desirable.

TABLE 7—MAXIMUM LIMITING PITCHES FOR LAP JOINTS

Diameter of Rivet	5/8"	3/4"	7/8"	1"	1 1/8"	1 1/4"	1 3/8"
" "Hole	11/16"	13/16"	15/16"	1 1/16"	1 3/16"	1 5/16"	1 7/16"
Plate Thickness							
1/4"	2 7/16"						
5/16"	2 7/16"	3"					
3/8"	2 1/2"	3 3/16"	3 1/2"	3 3/4"			
7/16"	2 7/16"	3 1/4"	3 3/4"	4 1/16"	4 5/16"	4 9/16"	4 13/16"
1/2"	2 3/8"	3 5/16"	4"	4 3/8"	4 9/16"	4 13/16"	5 1/8"

TABLE 8—RANGE OF PLATE THICKNESSES FOR VARIOUS DIAMETERS OF RIVETS

Diameter of rivet, inches	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8
Minimum thickness of plate, inches	1/4	5/16	3/8	3/8	7/16	7/16	1/2
Maximum thickness of plate, inches	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4

Double riveted butt and double strap joint for ¾-in. plate:—

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WATER PURIFICATION UNITS MOUNTED ON MOTOR TRUCKS*

By William J. Orchard
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In every line of endeavor, the world war brought forth many novel developments, and although the water supply field was but one of the many, it is pleasing to present before this convention of water works men, a discussion of the units developed and manufactured by members of this association, to be operated in France, and elsewhere, by other members engaged in delivering safe water supplies to the allied military forces.

The portable, motor-truck-mounted, water-purification units about to be described, present nothing new in the fundamental principles of water purification, but show the applicability of the principles used in stationary domestic plants, to portable plants for military use.

In 1914, the necessity for a specially organized water service was not recognized by any of the allied forces, water supply functions being the duty of engineering troops. The purity of the water was determined by the medical department.

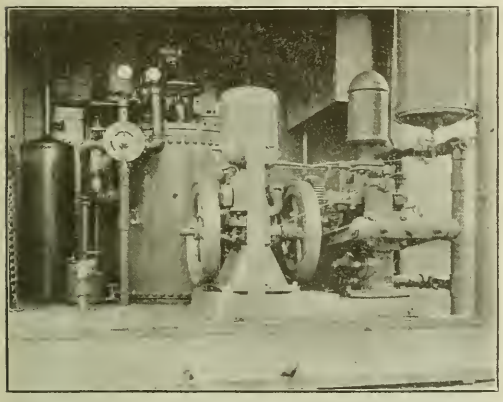

Fig. 1—Rear of Completed Truck, Showing Filters, Power Plant, Pump, etc.

The water supply conditions presented in France and in Belgium, and the problems of water supply met in trench warfare, were entirely different from problems presented in previous wars. The soils of Northern France and Belgium were for the most part highly cultivated, fertilized for scores of years with night soil and other refuse, so that water supplies normally obtained in the battle area were highly polluted. Then, too, the German forces, in passing over the country, indescribably polluted all water left behind when retreating, making special measures necessary for purification.

It is reliably reported that the 1915 Champaign campaign of the French army broke down largely due to inadequacy of water supply arrangements, and at the close of this campaign, the French war office organized a special water service for the Second French Army, under the direction of Major Bunau-Varilla, well-known through his endeavors to construct the Panama Canal with French financial support.

The chlorination of all water supplies used for drinking and cooking purposes, was required by the French military authorities. Calcium hypochlorite or sodium hypochlorite was applied in such quantities that fifteen minutes after treatment there remained two-tenths parts per million of residual chlorine.

*Paper prepared for the recent Buffalo Convention of the American Water Works Association.

It should be pointed out that such excessive amounts of residual chlorine, greatly in excess of American practice, left objectionable tastes and odors in the treated water, so that the troops were apt to take the more palatable, but dangerous, untreated water from flowing streams, shell holes and the like, when possible.

The United States forces, in entering the conflict, taking advantage of the lessons learned by the allied forces, created a water supply regiment, the 26th Engineers, which was

Fig. 2—Ready for a Long Journey

officered by experienced water works men, most of whom are members of the American Water Works Association. This regiment had charge of the water supply of the American Forces, both in the advanced area and in the rear.

Early in the war, the need for portable water wagons for the purification of supplies, was presented, and bulky equipment, with filters and devices for treating the water with hypochlorite, were put forth. In 1916, the availability of apparatus of American manufacture to control liquid

Fig. 3—End and Side Gates Down, Ready for Operation

chlorine made possible the first efficient motor-truck-mounted, water-purification unit.

Experience had been gained by the Wallace & Tiernan Co. through co-operation with its British house in the construction of equipment for the British forces. Equipment based on the British unit was constructed and tested under varying conditions at Maplewood, N.J. Water was taken

from the west branch of the Rahway River, a grossly polluted stream.

This first unit was equipped with rotary pumps, which did not prove suitable, and subsequent units were equipped with gasoline-operated force pumps.

Various members of the American Water Works Association, who were officers in the Engineer Corps, or in the Sanitary Corps, offered helpful suggestions and contributions toward the development of this unit, which, when placed in operation, gave highly satisfactory results.

FIG. 4—LABORATORY, LOOKING TOWARD DRIVER'S SEAT

Separate water analytical laboratory trucks were contemplated, and it was ultimately concluded to modify the design to permit the incorporation of suitable laboratory equipment. By building a separate room in front of the truck, using small cylindrical tanks for contact and storage chambers, and placing these tanks under the laboratory benches, a marked saving in the space required was effected.

Description of Operation

The water is pumped through a 50 ft. suction line of 2-in. steel-woven suction hose, fitted with bronze check valve and strainer, by the gasoline-engine-operated pump located at the rear of the body. A very heavy dose of chlorine is applied in the pump suction, from a manually-operated solution-feed chlorinator located on the rear wall of the laboratory room. When waters of low alkalinity are treated, soda ash is applied with the chlorine solution.

Passing through the pump, with a relief valve set to operate at 50 lbs. pressure, the water is passed to a specially designed pressure filter, being treated en route with alum through the standard dash-pot arrangement.

From the filter, the water passes through a 1½-in. water meter, thence through a diaphragm pressure-regulating valve to maintain constant back pressure on the chlorinator water supply line, thence through the storage and contact tanks located beneath the laboratory benches, to the point of discharge at the forward left-hand corner of the truck. Just at the point of discharge, the water is treated with sodium thiosulphate solution, regulated and controlled by a special dechlorinating equipment.

These units were designed having in mind the grossly polluted and befouled waters that would have to be treated. Based on the British practice and experience, high doses of chlorine were introduced into the raw water. The filters served to clarify the water, and at the trial tests, absolutely sterile water was obtained at the point of discharge.

It was thought necessary to make provision for removing the excessive residual chlorine that would be in the water after passing through the contact tanks, and a proportional pressure-feeding thiosulphate dosing device was developed. It should be mentioned that provision for dechlorinating was made in accordance with the British experience, which used the process of dechlorination, by the application of compressed sulphur dioxide gas, in all portable units.

On the British truck, the sulphur dioxide was controlled by a standard direct-feed manually-controlled chlorinator of American manufacture. On the American truck, the chlorinator used was the standard manually-controlled solution-feed type.

Control valves for the soda ash and thiosulphate solutions were in the rear of the laboratory below the chlorinator, so that all chemical application could be centrally controlled by the laboratory operator.

The first several trucks were constructed with horizontal pumps, and it was found that special provision was required to eliminate excessive vibration in the laboratory. With this in view, special spring supports were developed. On the later trucks, a vertical force pump was used, and this

FIG. 6—LABORATORY, LOOKING TOWARD REAR OF TRUCK

so eliminated the vibration as to obviate the necessity of special spring supports.

The development, construction and testing of the first lot of trucks, and the tests and recommendations of the Board of Inspection officers representing the office of the Chief of Engineers, the Engineer Depot and the Sanitary Corps, resulted in many modifications of design and rearrangement of equipment, but not in any change in the basic principles involved.

The value of these units became so apparent that increased facilities were required for their manufacture. An

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FIG. 5—TRAIN OF MOTOR-TRUCK-MOUNTED, WATER-PURIFICATION UNITS LEAVING FACTORY EN ROUTE TO FRANCE

PROGRESSIVE METHOD OF ROAD IMPROVEMENT*

By Gabriel Henry
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In a country with a comparatively sparse population grouped in centres generally remote from one another, the general problem of road improvement is solved by means of two methods which may be used concurrently according to the amount of money available. On the one hand there is the method generally followed for main communication highways known as "trunk roads." This method is the normal one which is of the same nature as that followed in building railways, with the same complete preliminary studies and a similar organization for carrying out the work. On the other hand, there is what is called the "progressive method," which is better suited for rural road properly so-called. The object of this paper is to call attention to this second method, to describe it properly and make its advantages known.

The population of the province of Quebec is scattered over a very large area, generally in groups and living on long ranges sometimes remote from one another, from railways and from main highways, at distances which, in a densely populated country, would be considered very great.

The consequence of this is that every rural municipality has a very considerable length of roads under its charge. The average length of roads per municipality in this province probably exceeds 40 miles. Some townships have as much as 100, 150 and even 200 miles of roads under their control.

Roads in Agricultural Districts

Their population is chiefiy an agricultural one and naturally has not sufficient capital for improving such a long stretch, all the more so owing to the fact that, outside the St. Lawrence Valley, the country is generally undulating and sometimes broken; on the other hand, agriculture and trade have greatly developed within the past four years, and the need of connecting rural municipalities with one another, with railways and highways is becoming more and more felt. The use of automobiles is increasing even in the most remote districts. Requests for roads, on which at least automobiles can run, are becoming more and more insistent every day and the problem is becoming complicated from a domestic standpoint. How can all these requests be even partly satisfied? Such is the question answered by the second method.

Needless work must be avoided and as little as possible of work offering but transitory or short-lasting advantages should be done. All the work executed should be with a view to real, progressive definite improvement, and preference should be given to the work urgently needed. Thus, the works on rural roads may naturally be classified in two principal categories: Works of a permanent nature, and works of a non-permanent nature.

This distinction, as will be seen further on, is very important not only from the standpoint of the capital to be spent in making roads, but also from a technical point of view. It also naturally applies to road-making according to the first method. It must never be lost sight of.

Permanent Works

Permanent works comprise: Drainage, underdrainage; bridges and culverts; earthworks; special work, such as retaining walls, rip-rap, random rip-rap, etc.; work of minor importance, such as cobble gutters, small dry stone walls, earth basins, etc.; lastly, the foundation, which is one of the most important of permanent works.

All these works are called "permanent" because their duration must be unlimited and because the capital spent on them must be a life-long investment. For instance, reducing the slope of a hill from 15% to 5%, is a permanent work. Interest on the capital required for this work is and will always be represented by a lower cost per ton-mile as well as by reduction in the cost of maintaining the road, and the amount of interest will be all the greater as the traffic on the road increases.

As a rule, the cuts and fills for improving the profile of a road are permanent works. Deviating a road to get around a low-lying or wet spot, when drainage and underdrainage cannot be done and where no top course can be maintained except at a heavy cost; raising, by means of a fill, a road running through a low place in order to protect it from dampness and from flooding along a stream, are permanent works. All these works must be so arranged for that the capital to be spent on them will permanently yield good interest through the advantages they will procure.

Straightening is Frequently Profitable

The straightening of a road in order to decrease its length, is also a permanent work. If, for instance, one reduces by half a mile the length of a road four miles long on which a wearing course has to be put which will cost $10,000 per mile, the total cost of that top course will be lowered by $5,000. Such straightening may sometimes be effected for a smaller sum, including the purchase of the land required, while the expense of its maintenance will be reduced by one-eighth. The more expensive top courses are, the greater will be the advantage of reducing their length by well-arranged straightening.

Concrete bridges and culverts to replace wooden ones, may last indefinitely if they are solidly and carefully built, and the interest on the capital spent on them will be represented by a decrease in the cost of maintaining the road. Wooden bridges are comparatively costly to keep in order and require to be rebuilt from time to time. This cost of maintaining and remaking bridges is heavier, as a rule, than the interest on the cost of properly built concrete bridges.

Generally speaking, the works called "permanent" in connection with road-making, are the same as for railways, less the cost of purchasing, transportation and laying ties and rails. To sum up, their feature, as we have just said, is the effecting of a life-long investment and they must always be understood and executed so that the investment may be an advantageous one. These permanent works also possess the following important characteristics:—

Annual Maintenance Costs Decrease

If properly understood and carried out, the yearly cost of their maintenance will be greatly decreased. Such cost is practically independent of the volume of traffic. It is greater, as a rule, during the years immediately following their execution and it decreases gradually, as the years go by, to a certain fixed lower limit as the road settles down and nature establishes a new equilibrium in the place of that which was disturbed by the execution of the work. In good ground, the new equilibrium is very soon attained and the cost of maintenance rapidly drops to a trifle. But, in bad ground the cost, which may have been rather considerable at the outset and for some years, always ends by reaching its fixed limit.

The maintenance expenses of these permanent works consist chiefly in keeping the slopes in order, clearing the drainage system, repairing the drystone works and the foundations, for the latter often sink owing to uncontrollable changes in the regimen of the underground waters.

Such are the economic features of permanent works. Comparison with non-permanent works will bring them out still more clearly. From an economic standpoint, non-permanent works do not absolutely, constitute a permanent investment, but are rather a yearly expense. In industrial accountancy, they would be considered as more or less transitory investments and be classed among those represented by cost of equipment. Expenditure in connection with them would be classed partly among the items interest, renewals, depreciation, and in the list of fixed charges, and partly among the items of labor, supplies and repairs in the operating charges.

Contrary to the permanent works, the maintenance expenses in connection with them vary with the traffic volume and also with their age. They are almost nothing during

*Paper prepared for the last convention of the Canadian Good Roads Association. Included in association's report of proceedings (now on press) but not read because Mr. Henry was ill during the convention.

the first years after being done and progressively increase during a certain number of years, determined by the duration of their useful existence, which may, however, be lengthened by increasing the yearly cost of repairs and maintenance.

The non-permanent parts of the road consist almost entirely of what may be called "wearing-courses" or "top-courses" and correspond to the whole of the ties and rails in the case of railways.

As the wearing courses, which last for some time, are expensive as a rule, it can easily be seen that in the case of non-permanent works, the items of interest, renewals and depreciation in the fixed charges on the one hand, and those of labor, repairs and supplies in the operating charges, on the other hand, are comparatively high, and that consequently, the choice of top courses and their use is one of the most important problems in connection with road-making.

A Typical Problem

When we consider the general problem of improving the highways of a province or of a state, the pre-going remarks lead to the conclusion that in the case of roads, there is no drawback in doing permanent work progressively from year to year on roads, provided a well-defined plan has been adopted and is followed and that no work, or as little as possible of work, of a more or less temporary nature is done.

The following example will make this better understood:—Let us take a road 40 miles long which connects two important rural centres or makes a short cut between two main roads and runs, for instance, through five villages and a district exclusively inhabited by farmers and by settlers far from one another; a road which the population is really unable to maintain properly owing to difficuties in connection with the nature of the land and lack of money; which is impassable during a portion of the year and on which automobiles can hardly venture. Let us suppose that at present, in order to go from one centre to another, one must do so by rail or by a long round-about way and the five villages between the two centres are consequently isolated; that if this road was made at least passable, relations between the two centres and the villages would become more active, that the value of the properties along it and in the district generally would increase; and lastly, that this would greatly accommodate the travelling public in general, would promote the development of motoring as well as relations with the interior of the district and with neighboring districts.

Obstacles to be Overcome

On a length of six or seven miles this road is encumbered with large boulders, there is a hill with a 20% grade and two other long ones with a 15% grade all three being actually climbed with difficulty; there are also eight low-lying spots impassable in rainy weather. The bridges and culverts, mostly wooden, are in bad condition and even dangerous. In many places there are dangerous and soft springy spots and bad holes. The remainder of the road is nearly passable. There are field stones in the adjacent fields and good gravel banks here and there in its vicinity.

The chief obstacles to the opening of this road are the three hills, the rocks in the road, the low-lying spots and the soft springy spots. If only these defects were removed the road would become passable and automobiles could run over it.

The problem is this: Shall the road be built immediately at a great expense according to the normal method followed in the case of an entirely modern road with an improved wearing course, or shall capital be spent progressively and judiciously on the works of a permanent nature most urgently needed to open it at once to traffic?

By virtue of what has just been said, there is certainly no doubt that the second method is not only the most justifiable, but also the more advantageous, all the more so as there are many similar cases in the country to be considered, the carrying out of which according to the first method would necessitate the immediate investment of a considerable amount of capital.

It seems reasonable, therefore, first of all to improve the hills and to fill in the low-lying spots with the stones to be found in quantities in the neighboring fields. This filling can be done at first on a sufficient width of road to allow for vehicles passing over such spots without danger and the road may afterwards be widened as funds become available. The boulders should be removed from the road and the soft spots permanently cured.

All these works are permanent and the money spent on them will be a good investment, they will not cost much and in a short time in a single season the road might be made passable for automobiles. Improvements may be made, year by year, until the whole permanent portion of the work is finished, including even the foundation. A modern top course should be laid as soon as it becomes necessary, beginning at the villages where traffic concentrates, in the vicinity of the churches and shops. It is curious to note, even with a small investment in permanent works of this nature, roads can rapidly be made passable when the farmers themselves work at the improvements and furnish the stone which they remove from their fields.

This manner of proceeding is called the "progressive method." It progressively increases the value of the immoveable property of the country. The capital so spent is, or should be, as has been said, a good investment. This method must not, however, be followed to an exaggerated extent, for when a trunk road has to be built, traffic rapidly becomes so considerable that the laying of a regular wearing course becomes necessary at once and, in such cases, the normal method is the only justifiable and recommended one.

A full study of the various works above mentioned would take too much time under present circumstances. The following important remarks should, however, not be forgotten.

Complete Details Not Planned

When the progressive method is followed in improving a rural road, a complete study of the details and a general detailed plan with cross-section of all the road are not usually made beforehand. The details are studied only as need arises. Then it must not be forgotten that works which are not permanent or not of a sufficiently permanent nature must never be done and that all the capital spent on improvements must constitute a life-long and paying investment; and again that, in doing such works, they should be done so that it will never be necessary, when completing improvement work; to undo and do differently any works already done.

As rural roads are sometimes very winding and of irregular width, it is often difficult to obtain the land required for straightening them and equalizing their width. Consequently, when this method is followed in winding places of regular width, the axis of the road should be traced and given such a direction that it may, in each case, be prolonged in a straight line as far as possible, reserving enough land on either side between the ditches for the roadway proper and for suitable shouldering. The inequalities in the ditches and in the width of the shouldering may be attended to later on, but the roadway itself should be built in straight sections as long as possible. It is a permanent work which should not have to be begun over again later on. The straight sections should be connected by curves having as large a radius as possible. This radius should never be less than 300 ft. With such curves care should also be taken to raise the outside of the road higher than the inside before laying the foundation.

Heavy and Light Work

In this method as in the normal method, earth work is divided into heavy and light work, but with a difference. As in the normal method, heavy earth work consists of large fills and cuts of which a special and complete preliminary survey, with plans and cross-sections must be made. Such work must be staked out separately, but may be performed in sections at different times as funds becomes available. In this method, light earth work usually comprises light grading, cleaning ditches, etc., outside of sections staked out for heavy earthwork. In these sections no heavy work is to be carried on. Such sections are also separately staked out. Light grading may be largely performed by means of the road machine, and is generally carried out without a special preliminary and complete survey but under the superintendence of a competent foreman accustomed to such work. In

this method, heavy earth work is reckoned by the cubic yard, light work by the mile. It must be added that road lengths requiring heavy earth work represent as a rule only a small proportion of the total length.

Cutting Down Grades

It is useless to reduce gentle slopes but it should not be forgotten that a road with a very wavy longitudinal profile is most disagreeable. Hence all the slight undulations in the road should be machine levelled so that the slopes may everywhere be gentle and regular and their length nowhere be less than from 150 to 200 ft.

If 5% be the maximum limit allowed for grades of steep hills, it is useless to reduce slopes of less than 5%, unless they are too close and form narrow ravines, in which case it is better to reduce to 3 or 4%, and sometimes less.

In the method of progressive improvement, it is better where there is no heavy earth work to do, and whenever possible, to proceed by successive thin layers which are beaten down by traffic one after the other and cause less obstruction. When too much digging is done at the same time and too deep layers of earth are spread on the surface of a road, the latter usually becomes impassable in rainy weather and dragging is more costly.

No road can be kept in good order if its substructure is damp. No wearing course, however costly it may be, can last on an insufficiently drained substructure. It is needless to insist on this universally admitted fact. Drying and draining the road are difficult undertakings and call for much experience, judgment and time.

Drainage and Underdrainage

To dry and drain a road there are two requisites: First, to drain off rain and melted ice and snow as rapidly and completely as possible; second, to dispose of the dampness which the subsoil always contains.

The surface waters are discharged; subsoil moisture is removed by underdrainage. *Drainage* and *underdrainage* are the two essential requisites for starting road improvement. They must be undertaken beforehand because a real and sufficient solidifying of the substructure through underdrainage often cannot be obtained in our climate before several months and sometimes a whole year and even more. Drainage is obtained by means of a complete system of ditches, gutters, culverts and bridges.

Ditches should not be dug or maintained where they are not absolutely needed. Of the permanent road works, ditches are the most expensive to maintain and their length should be reduced as much as possible. They should also be made as shallow as possible. Deep ditches, besides being expensive to keep up, are very dangerous. Deep ditches are often supposed to dry the body of a road. It is not always the case; in this climate, it is so only in soils which easily part with their moisture.

Construction of Ditches

Permanent ditches should be as straight as possible. Winding ditches are more exposed to erosion by water and consequently cost more to keep up. The longitudinal slope of ditches should not be less than five inches per hundred feet when it is possible without too much expense. Nor should the slope be too considerable, on account of erosion. Naturally in more resistant soil it may be more pronounced. They should empty rapidly and completely after rain and retain no stagnant water at any place. Their side slopes should not be over 45 degrees. When the latter are steep, they should be strengthened by means of dry stone walls or rip-rap, at least up to a certain height. Where the slope is pronounced and the land non-resistant, the bed should be paved to prevent erosion, and the curves reinforced by dry stone walls. The gutters should be the continuation of the shoulders and no stagnant water should remain in them anywhere in hollows. The outlets in which the ditches empty should be put in order and be large enough easily to carry off all the water they receive under the heaviest rains.

To sum up, the ditches, gutters, culverts, bridges and outlets all together should form a system capable of draining completely and as rapidly as possible and without erosion anywhere, the water from the heaviest rains and spring thaws, leaving no stagnant water in hollows.

In the subsoil there is nearly always a sheet of subterranean water at a certain depth. The depth at which it is met with varies greatly from one point to another. It varies also with the seasons and diminishes in the spring. In many places, the level of this sheet of water is almost flush with the soil and when the spring thaws occur it rises even above the soil. On the other hand, there are soils in which the water easily rises by capillarity, and also soils which hold fast water absorbed by them. When the sheet of water is at a small depth and the ground covering it of the former nature, the water may rise by capillarity to the level of the soil. The air circulating at the surface of the soil evaporates this water and there is thus established a kind of vertical current between the sheet of water and the surface. Though the surface appears dry, the subsoil is moist and soft. If the surface is covered with an impervious wearing course, the action of the air is no longer felt, the water continues to rise until the soil is saturated and the earth becomes still softer.

The Plague of Roads

In cold weather all these moist earths easily freeze to a great depth and then swell. When earth freezes water is attracted, as it were, by the ice crystals forming everywhere, especially at the surface. In the process of freezing land can absorb much more water near the surface and hold it in the shape of ice than it could absorb and hold under ordinary temperature conditions. Thawing begins at the surface. As the water cannot escape through the subsoil which is still frozen, or clayey, stony or of some other impervious substance, it gathers, producing "soft spring spots" on a foundation of ice, clay, rock or generally impervious substance.

These spots, called by the farmers "ventre de beoufs," are truly the plague of roads in this latitude. They are to be found everywhere. They occur every year at the same places, making roads dangerous until the end of June. They even occur on improved roads at places where they did not previously exist. All earth should, therefore, be freed as completely as possible from subterranean moisture before a road becomes sufficiently resistant.

V-Drains and Cobbled Trenches

Work, whose object is to free the soil from subterranean water and drain it, is called underdrainage. This underdrainage is done by means either of earthen or concrete pipes or of field stones. The object is to prevent water from rising in the soil by capillarity to less than 18 ins. beneath the bottom of the foundation.

Drain pipes should be used only when springs are met with or when the surface of the subterannean water rises at times or remains continually at a small depth beneath the surface of the soil. This is ascertained by digging small wells to a depth of about 4 ft. If at the end of 24 hours, for instance, water is found there, the surface of this water marks the level of the subterannean sheet of water, and pipes should then be used. If no water appears and the earth is still moist and soft, it is the case previously mentioned of land absorbing and holding humidity. In such lands, which frequently contain soft, springy spots, pipes have little or no effect. Other means must be used. Generally, field stones are disposed in thick layers, serving at the same time as foundation, made in the shape of a V to economize stone and to drain the water, or else trenches filled with cobble stones are used. V-drains are frequently expensive on account of the large quantity of stones required. Drains made of trenches filled with cobble stones, when they are judiciously used, well laid and proportioned, give as good results in the long run and are less expensive.

Obviously, drying and underdraining the subsoil, while indispensable, are not always an easy task, and it may be said again that suitable results take much time to achieve unless the cost is increased in order to obtain a quick result. However, it is drainage and underdrainage that should be first carried out in order to allow the soil to dry and settle

before laying the wearing courses. The modern top courses are generally expensive, and it is neither recommended, nor even justifiable, to risk them when the substructure is not sufficiently dry or firm, even though there is a good foundation.

The progressive method of improving roads gives all the time necessary for a proper preparation of the substructures, and traffic hardens them. When the time comes for laying the foundations and top courses, the firmness of the soil on which they are to be laid is accurately known. It must always be borne in mind that undulations in the wearing courses which appear after a few years, are nearly always due to lack of firmness in the substructure, whatever the resistance of the foundations and the quality of the materials may be. Undulating surfaces with many depressions will be found even in wooden pavements resting on concrete foundations, due to the above cause.

Foundation Problems

The foundation is one of the most important things in road-making. Its object, as everybody knows, is to distribute wheel pressure over a sufficient surface of the structure so that the latter, and consequently the wearing course, will not be sunk or perforated by the wheels. It constitutes a resistant protective cushion between the wearing course and the soil. Foundations are classed among the permanent works because they have all the above-mentioned characteristics of such works.

In laying foundations it must always be borne in mind that a permanent work is being done, and care should be taken to make it a durable one. Vehicle wheels must never reach them, and they must be thick and solid enough to prevent their being broken or crushed out of shape by the heaviest vehicles. This, unfortuntely, has not always been understood, and there have been many disappointments, especially since heavy trucks have come into use. At present this is better known and is receiving more attention.

Foundations are made of concrete, stone, boulders or gravel, and even of sand when the soil is clayey. Without entering into the details of their construction, it is nevertheless useful to call attention to the following points of importance: Homogeneity and hygroscopicity. When stones of different sizes are used in making the foundations, the different sizes must be laid one upon the other in uniform layers, and they must not be made throughout their whole thickness of stones of the same size in one place and of another size in an adjacent place. Too much gravel, dust or sand must not be used at one place to fill voids and a smaller quantity in another location.

Materials of Uniform Size

The best foundations are those made of uniform size throughout all their thickness and laid in a uniform manner. When stones from four to six inches in size are used, they must be of good quality, pressed solidly against one another by hard rolling so as to break the excessively thin corners and edges and to interlock them firmly. If the stones are unstable, too soft or alterable, the vibration caused by passing vehicles will wear them out at the points of contact, and, in the long run, the foundation will sink irregularly.

The stones must touch each other, and filling the voids with too much dust, sand or even gravel is another drawback, as the stones then will not touch; and in such a case the firmer particles have a tendency to drop and the larger pieces of stones to rise, at least in this climate, causing, in the long run, harmful movements and some kind of segregation in the foundation.

Foundations of coarse sand, not hygroscopic, where laid on clay soil, give good results under water-bound macadam, and are economical in places where stone is dear. Well-made Telford foundations are excellent, but very expensive.

The concrete foundations are the best, but their cost is generally considered too high in the case of rural roads. They are subject to cracks in soil not dry or firm enough, especially on account of frost, and it frequently happens that the cracks rise to the top course.

In calculating the thickness of foundations, it is absolutely necessary to take the heavy weight of modern motor trucks into account.

Temporary Gravel Roads

When the regular wearing course is laid, their solidity and lowed, foundations may be laid long before the regular wearing courses, and may, if covered with a layer of gravel, be used as gravel roads until a regular top course becomes necessary owing to increased traffic. During the interval, the roads are kept as gravel roads, and arrangements are made so that, when the regular wearing course is laid, it will not be necessary to scarify them or do any other work over again. Following the same method, the foundation may also be made wholly of gravel covered with an additional layer of gravel, and used as a gravel road till a regular top course becomes indispensable.

The temporary use of foundations covered with gravel as a wearing course allows of regular compacting by the traffic and of correcting their defects whenever they appear. When the regular wearing course is laid, their solidity and resistance are exactly known. The soft places have become hardened, and there is less likelihood of the defects which occur in wearing courses laid on an insufficiently firm foundation.

I may add also that, in this province, the rural roads are covered with snow during a portion of the year, and, consequently, the wearing of the top courses of the rural roads by traffic is much less than in countries where there is traffic throughout the year, and this may have much influence on their choice.

It would be advisable also to consider substituting one kind of top course for another, taking existing conditions in this province into account; also to consider what precautions should be adopted when laying cheap temporary top courses for avoiding certain expenses which otherwise would be incurred when it becomes necessary, owing to increase of traffic, to use them later on as foundations and to cover them by improved top courses.

Senator G. D. Robertson, Minister of Labor, has notified D. K. Trotter, secretary of the Association of Montreal Building and Construction Industries, that the association will be invited to select its own delegates to the National Industrial Conference to be held Thursday, September 11th, in Ottawa.

The annual convention of the Associated Boards of Trade of Vancouver Island was held July 10th in Courtenay, B.C. The principal proposals endorsed were the extension of the Esquimalt & Nanaimo Railway to the northern end of the island, the construction of about twenty-two miles of road to open the Sayward district for settlement, and the continuation of the Strathcona Park road.

"Town planning in Great Britain," says "Conservation," "has so far advanced beyond the experimental stage that it has now been decided to make it compulsory for every town, having 20,000 inhabitants or more, to submit a town planning scheme for its own area to the Local Government Board, not later than 1926. The British people realize that haphazard growth of towns leads to serious evils and they are determined to control it. In future, land will have to be developed so as best to serve the interests of the community, which, in the long run, is usually in the interests of the landholders themselves. Only the land speculator is adversely affected. If the public wish to put that individual out of business, they cannot do it more effectively than by actively promoting proper schemes of town planning. In Canada, the province of Nova Scotia took the lead in making town planning compulsory in 1915. The only other province which has a compulsory Act is Saskatchewan. These are therefore the only two provinces abreast of the Old Country in town-planning progress, though most of our provinces have enabling Acts in force."

COLLECTION AND DISPOSAL OF REFUSE IN THE FUTURE*

By F. W. Brookman
Cleansing Superintendent, Rochdale, England

GENERALLY speaking, refuse collection resolves itself into transport and loading strength; and transport may be petrol, steam or electric, or horse-drawn vehicles.

Petrol wagons, in spite of the cost and difficulty in obtaining petrol, have been a great help during the war, and I want to suggest that as the cost of the wagons gets easier and the petrol becomes more plentiful, the home-manufactured benzol should be used either alone or mixed with petrol, for several reasons. First, it is an English product, and before the war was less in price than petrol, while 15% more power can be got out of the gallon. It is a saving in shipping also, and for some years to come we shall have none too many ships to carry the trade of the country, to say nothing about buying petrol abroad when we have a good home-made article. For all users of petrol vehicles it would be a good thing if there were inspectors on the road to send home all badly-running vehicles, and if the wagon was taken in hand at the first warning there would be many less breakages.

While many of the petrol wagons were commandeered early in the war, the better type of steam wagon seemed to disappear entirely, and thus municipalities had not the same chance with these as with the petrol wagons. The fact that they were extensively used in France and elsewhere on road-making and repair, points to their use after the war for the heavier classes of work, and where transport schemes are being fixed up, they will no doubt be much used for the heavier traffic such as road materials, coal, etc.

The Choice of Wagons

It is not always easy to decide what size of wagon is the best to adopt, but where its work is more or less of a certain type, or, shall we say, suppose a wagon is to work nine-tenths of its time on one job, naturally that job should rule the size, and it should always be remembered that a 6-ton wagon costs no more in labor to run than a 4-ton does, and there is less time taken per ton at each end of the journey getting into position and also in loading and unloading.

The electric wagon has been much to the fore during the war, and could they have been obtained there is no doubt that they would have been in evidence almost everywhere. Where they have been adopted for comparatively level work I have heard them well spoken of, but in cases where the roads are other than level this has not always been the case. This does not by any means condemn the electric wagon, but only shows that sufficient care has not been exercised in purchasing the wagon, or that the makers may have been so eager to sell that they have sold a less power wagon than was warranted for the work in view, and that both buyer and seller be to blame. Of course, this also obtains with petrol wagons, and a wagon is purchased for 30 cwt. load and often works to 2 tons and trouble soon results. To my mind the electric wagon is a most economical wagon to run if of a sufficiently powerful type without it being necessary to undermine its constitution by want of energy.

Horse Transport

We now come to our old friend and servant the horse. Owing to the high price of horses and provender it is now a question as to just where the dividing line should come in. This must depend on the district, for in one case it may pay better to work a horse in a four-wheeler as far out as a mile, while in another case half a mile might be over the mark. Now that the 48 hours is the limit, the horse journeys may be so shortened that the old number of journeys can be done, and the quicker-moving motor wagons put on all outside the horse area. In this outside area you can use either a moderately-sized wagon or a wagon about half the size and holding about the same as a horse four-wheeler. Suppose, however, you put on a large wagon and put all the men on it that you would put on to three small ones, your result would be nothing like the same. You might possibly not get done more than half what the three small wagons would do because of the distance the large wagon would have to travel to get a load, and the unwieldy character of the machine in small areas.

Tipping and Loading

As to tipping wagons, the tipping arrangements should be of the simplest possible character. The experiment has been repeatedly tried on two wagons—one a tipper and the other a non-tipper—of moving the same material from and to the same place, and the non-tpper could easily beat the tipper owing to the character of the tipping arrangements.

Whenever possible the vehicle should be such as to be readily loaded by a man on the pavement without the use of a ladder. Wagons of the type used at Bury are easily loaded and tipped, and it is not difficult to get comparatively low-bodied wagons of other types to fill this requirement, and recently I have seen steam wagons that could easily be loaded over the side and at the same time give a passable tip. These wagons will carry up to 5 tons in weight and run well on coke breeze, with which a cleansing department could easily supply itself from the refuse.

The matter of the blowing about of dust, etc., by the wind during the operation of loading is very important, not only from the annoyance caused to people in the vicinity, but also from the fact that this dust once adrift never ceases (as long as the wind lasts) to annoy someone, and even the street-sweeping machine helps to make the nuisance worse, unless it is of the sprinkler type and thus brings the dust to rest.

It is not easy to find a complete cure without disadvantages. There are carts and wagons elaborately covered in and having side or flap doors through which to pass the refuse. There are vans with bodies partly covered over with a permanent hood, and from the end of this hood an ordinary sheet covers the remainder. There are wagons and carts with lorry poles down the centre, supported by iron hoops, something like a grocer's lorry with rain-sheet spread; and there is the loose cart or wagon sheet tied down at the front end on to the cart, wagon or lorry, and unrolled as it is required to cover the refuse and tied down so far each time in sections as the load is completed. These are all more or less satisfactory, and in some places more than others, for in some towns strong winds are much more prevalent than in others. The disadvantage is that the loading, etc., cannot be so easily watched or checked as with open vehicles. The wear and tear with permanent covered vehicles is considerable, and the additional weight is a great consideration, particularly in hilly towns, which, as a rule, are also those towns with more than their share of wind. It has been suggested that ash bins should be taken to the depot and there emptied, which, while being the ideal method, I am afraid will not appeal to us at this time of high prices, for by working in this way every load would be as great a weight of bins as of bin contents, and this is absolutely out of consideration. Further, to work in this way the municipality would have to own and supply all the bins and keep them in repair. I fear we are not yet in a position to do this.

I take it, then, that it is up to each authority—and, of course, every official—to decide what alterations they can make in methods of collection, and particularly think out the problem as to which is best adapted to their respective district, because it does not follow that the electric wagon will be best for Halifax or Bradford just because it does well for Southport or Blackpool.

Position of Ash Bins

In connection with refuse collection, another point requires constant attention in the future. In many districts now a wagon could be loaded in half the time at least, if the ash bin or ash place were accessible from the passage without having to go the length of the garden or yard, not to mention locked yards. I thing the position of the ash bin is an important item on a building plan, and that it should be

*From a paper read at the annual conference of the Institute of Cleansing Superintendents, England.

put in the most accessible position. In the case of old property it would be time well spent in many cases when any alterations or repairs are being executed, whether to the ash-places or not, to talk the matter over with the landlord and point out to him not only the advantages that an alteration in the site of the ashplace or bin would be to us, but also how such an alteration would benefit him and his tenants. It is no uncommon thing for a load in one particular district to take as long as two loads in a better arranged part of the town.

Another point that tends to waste time is where dwellings have their own particular utensils for containing ashes and refuse, in which case every particular bin or tub has to be carried back again after being emptied into the cart or wagon. In some cases the refuse must be carried from the back round the end of the house to the front and the length of the front garden or lawn into the front street. These are the places that waste time, get the men out of sight, and cause trouble all round.

Sometimes we do see something quite contrary to the time-wasting process above mentioned, and I shall never forget a little performance I once saw in the collection of refuse.

I had appeared on the scene quite without notice, and in the absence of the local superintendent. The ash bins (all galvanized) were previously deposited along the kerb-stone edge by the tenants, and while the motor wagon travelled up the centre of the street the ashmen simply hoisted up the bins onto the wagon (without it stopping) and the man in the wagon picked up the empty bin and dropped it over the side into the hands of the man who brought it. I thought that was ideal refuse picking up. Unfortunately, ninety-nine towns out of the hundred have not the authority to order the tenants' ash-bin to parade at the kerb-stone. I suppose there is often a fly found in the ointment, and while in the case cited I did not find it, in some cases where the "kerb-stone parade" is in vogue, an awful mess is made in the street by rag-pickers and others pulling the stuff over.

Special Collections

Prior to the war in many towns there were special collections (besides the refuse and nightsoil or excreta) of waste fish and butchers' offal, infectious fever pails, fruiterers' refuse, etc., and during the war others have been added such as paper, leather trimmings, broken food, rubber, potato peelings, etc. As to how many of these will fall out again, only time will demonstrate. While in some cases it was necessary to use every effort to obtain certain materials irrespective of cost during the war, it is quite certain in some cases that such effort is not being maintained, and time only will demonstrate how many of the above will lapse. One thing is certain, with the present price of labor even municipalities cannot be expected to pick out and collect materials which are difficult to dispose of and at the same time do not pay for the handling; for while such collections were very necessary during the war, the end of that catastrophe ends the necessity.

Disposal of Refuse

Having collected the town's refuse, we must dispose of it in some way.

I want you to realize the fact that if you have anything at all you can make into a decent manure, it is up to you to do it, and I do not think you are likely to create a glut in the market in that direction.

In a few towns the pail contents are dried and thus made into a valuable manure, for the mere act of drying (along with a little acid) can under certain conditions increase the percentage of ammonia up to 12%, which makes it work out about half as much as sulphate of ammonia for this item alone, and there are also present certain phosphates, potash, etc., so that it is a good all-round manure. The production will continue until the pails are replaced by water carriage, when we shall look to the sewage works to have produced a good substitute, and they will have no little problem in that the town manure will be intermixed and partly dissolved in millions of gallons of water.

With reference to the ash refuse we are not much nearer a good solution. In pre-war times it was almost the unanimous opinion that the refuse should be burnt so as to get rid of the putrefactive or organic matter and to make an innocuous clinker that could be used for many purposes, or tipped anywhere without being detrimental to health. While the matter of cost was at the time fairly heavy, both in collection and burning, it was low compared to what it is now. Given that we shall eventually exterminate the pail closet, there is no chance of eliminating the ashes collection, for while it is possible in certain factories and manufacturing premises to establish suction conduits to carry off the dust, sawdust, shavings, shoddy, etc., it would be quite a different problem to instal a system to draw away to the depot or the tip the ashes refuse of a town, intermingled with the pots and pans, tins, broken bricks, etc.

Screening and Washing Plants

Recently there have been put down screening and washing plants for screening out of the refuse the cinders and washing them so as to recover this valuable fuel. This, of course, separates out the inert fine ash—a material in itself which cannot be burnt, and which acts as a drag on the burning of the better fuel. Further, this is taken out at the first handling, and thus is not left either to be matted up against the clinker in the destructor and afterwards laboriously withdrawn and deposited on the clinker bank, or to be as laboriously riddled through the destructor grate if the stoker is sufficiently energetic so to dispose of it. In my opinion the screening of the refuse is a much better proposition than grinding up the whole of the material, good and bad, for it does enable you to use the good fuel, which, in its turn, may be used as fine ashes later. As I previously mentioned, the inert fine ash is thus eliminated from the good fuel, which is then washed to dispose of adherent damp ash, etc. Where the fuel is to be used for steam raising (or like purposes) on the premises, the washing may be dispensed with and the plant simplified; but this must, of course, be left to local requirements. In some particular cases it may suit the conditions to get all the fine ashes possible, but I wish to point out that the material that will not pass through a $\frac{1}{4}$-in. screen is not the same class as that which will go through it; and even if you grind it the composition remains what it was before, and unless you want the material purely as an absorbent or as a mechanical lightener of clay land, you may have had your labor for nothing. Supposing, however, you ground the clinker to a fine powder, you would render the lime contained in it available for agricultural purposes, and (depending upon the kind of coal used in a particular district) it would act on the land in exactly the same way as the lime in sewage sludge does, but it would save the carriage of the water in the latter and be much easier to spread and to work in. The availability of the lime for this purpose would depend upon its fine grinding, just as it will be remembered the now much-valued basic slag many years ago failed for want of proper milling. In that case the Germans bought all the production, and we have not yet fully recovered; but the war has set the material at liberty again.

In the past many novelties have been tried in the shape of moving and rocking grates, high blasts and low ones, fan and steam blasts, etc., for our furnaces. Top feeds, back feeds and feeds in front, by hand and machine, sloping and flat grates and furnaces without grates at all; many fairly successful, other failures, and still we have not the ideal furnace into which the loads can be tipped in bulk, and while everything combustible is consumed, what is not consumed is melted and comes away from the furnace (without laborious clinkering operations) in the fluid condition. Attempts have been made in this direction, but as yet without success, owing largely to the refractory nature of a very small percentage of the whole, acting as a block to the operations. I feel sure that eventually this will be overcome; but while the necessity for screening refuse might then cease, the average percentage of the clinker produced is not likely to be below 33%, in spite of the assurance of some years ago that two-thirds of ordinary destructor clinker could be easily consumed.

RIVETED JOINTS FOR STEEL PENSTOCKS AND TANKS

(Continued from page 200)

In Table 6, for ¾-in. plate the thickness of butt strap is given as ½ in. In Table 8, the minimum rivet diameter for ¾-in. plate is ⅞ in., and the maximum for ½-in. plate is 1⅜ ins.

First trial: Assume 1⅛ ins. diameter rivet and a long pitch of 16⅜ ins. Then

$t = 0.75$ in. $c = 95{,}000$ lbs. per sq. in.
$P = 16\frac{3}{8}$ ins. $= 16.375$ ins. $s = 44{,}000$ lbs. per sq. in.
$d = 1\frac{3}{16}$ ins. $= 1.1875$ ins. $S = 88{,}000$ lbs. per sq. in.
$a = 1.1075$ sq. ins. $b = \frac{1}{2}$ in. $= 0.5$ in.
$f = 55{,}000$ lbs. per sq. in.

$A = Ptf = 16.375 \times 0.75 \times 55{,}000 = 675{,}469.$

$B = (P-d)tf$
$= (16.375-1.1875) \times 0.75 \times 55{,}000 = 626{,}484.$

$C = NSa+nsa$
$= (8 \times 88{,}000 \times 1.1075) + (3 \times 44{,}000 \times 1.1075) = 925{,}870.$

$D = (P-2d)tf+nsa$
$= [(16.375-2 \times 1.1875) \times 0.75 \times 55{,}000] + (3 \times 44{,}000 \times 1.1075) = 723{,}690.$

$E = (P-2d)tf+dbc$
$= [(16.375-2 \times 1.1875) \times 0.75 \times 55{,}000] + (1.1075 \times 0.5 \times 95{,}000) = 630.114.$

$F = Ndtc+ndbc$
$= (8 \times 1.1875 \times 0.75 \times 95{,}000) + (3 \times 1.1875 \times 0.5 \times 95{,}000) = 846{,}094.$

$G = Ndtc+nsa$
$= (8 \times 1.1875 \times 0.75 \times 95{,}000) + (3 \times 44{,}000 \times 1.1075) = 823{,}065.$

$H = (P-4d)tf+nsa$
$= [(16.375-4 \times 1.1875) \times 0.75 \times 55{,}000] + (3 \times 44{,}000 \times 1.1075) = 625{,}721.$

$I = (P-4d)tf+ndbc$
$= [(16.375-4 \times 1.1875) \times 0.75 \times 55{,}000] + (3 \times 1.1875 \times 0.5 \times 95{,}000) = 648{,}756.$

$e = H/A = 0.926 = 92.6\%.$

Maintaining the same diameter of rivet, a long pitch of 16½ ins. gives an efficiency of 92.7%. The short pitch in this case is 4⅛ ins., which is approaching closely to the maximum limit for caulking that should be used.

Using 1⅜-in. diameter rivets, the maximum permissible pitch may be increased above that for 1⅛-in. rivets by 1½ times the change in rivet diameter, making $P = 18$ ins., for which the efficiency is 92%.

To obtain an efficiency of 92.7% with 1⅜-in. diameter rivets, a long pitch of 19¾ ins. is necessary. Since this exceeds the 18-in. limit, it cannot be used; therefore the proper joint is obtained by using 1⅛-in. diameter rivets with a long pitch of 16½ ins.

To find the necessary thickness of butt strap,

$b = [P/2(P-nd)]te.$
$= [16.5/2(16.5-4 \times 1.1875)] \times 0.75 \times 0.927.$
$= 0.489$ in.

Therefore, butt straps ½ in. thick, as given in Table 6, are sufficient.

PUBLICATIONS RECEIVED

MANUFACTURE OF MUNITIONS IN CANADA.—Presidential address of H. H. Vaughan at the last annual meeting of the Engineering Institute of Canada. 92 pages and cover, 6 by 9 ins., illustrated.

TESTING OF ANEROID BAROMETERS.—Bulletin 42 issued by the Topographical Surveys Branch of the Department of the Interior, Ottawa, describing the testing of aneroid barometers at the laboratory of the Dominion Lands Surveys, and commenting briefly on the errors of aneroids and their general characteristics.

D. H. McDougall, president of the Nova Scotia Steel & Coal Co., Ltd., has completed, for his company, the purchase from the British Ministry of Shipping, represented by Director J. B. Whyte, of New York, of the coal-handling plant at the Canadian National Railway terminals, Halifax.

WATER PURIFICATION UNITS MOUNTED ON MOTOR TRUCKS

(Continued from page 202)

admirable factory in Camden, N.J., was obtained, and here, in conjunction with our construction work, a school was conducted for Sanitary Corps men, members of the water-tank train, and officers who were to have charge of the trucks in operation.

Fig. 2 shows the units as finally developed, closed and ready for the road, and the detailed arrangement is indicated by Figs. 1, 3, 4 and 6.

Fig. 3 shows the rear of the completed truck, with the rear and side gates let down for operation. The gasoline storage tank is to the right of the pump. The provisions made for carrying and chaining the suction hose are shown.

The filter, central control valve for operation of the filter, soda ash solution tank, alum pot, dechlorinator and further details of the pumping room are shown in Fig. 1.

Arrangement of Apparatus

In the upper right hand corner of Fig. 1 may be seen a tool box in which a complete set of pipe cutting and fitting tools are kept, in addition to hand tools needed about a machine shop, and beneath this tool case, is the chemical bin for storage of alum, soda ash and thiosulphate.

The laboratory arrangement in the final truck is shown in Figs. 4 and 6. The provision made for carrying chemical bottles is indicated, as is also the sink for washing glassware, and a hand air-pump for creating pressure in the storage tanks when the pumping equipment is not in operation. A 37 deg. incubator for bacteriological samples, oven for sterilizing glassware and electric lighting equipment are shown, while in the rear of the laboratory is seen a standard solution-feed chlorinator, and beneath it, the thiosulphate and soda ash controls. On the bench beside the chlorinator is a pressure auto clave for sterilizing purposes.

The first several trucks were mounted on 3½-ton White truck chassis, but by far the largest number were mounted on 5-ton, 17 ft.-wheel-base Pierce-Arrow chassis. Novo 8 h.p. gasoline engines were used, with Gould 5 by 5-in. force pumps. The filter was constructed by the Roberts Filter Mfg. Co., of Darby, Philadelphia, Pa., and the electric lighting equipment by the Vesta Storage Battery Co. The rated capacity of the unit was 1,000 gals. per hr., although the actual delivery was nearer 1,500 gals.

The support of the filter, which weighed 2,400 lbs. without the water, presented problems that required careful study. The final solution was to fasten 5-in. steel H-beams to the chassis frame by U-bolts, bolting the filter to the H-beams by feet cast on the special filter base.

Over Thousand Articles Carried

In addition to the equipment shown in Figs. 1 and 3, 1,031 articles were carried; still, much to our dismay, when the trucks were first placed in operation, we found that we had overlooked the very obvious item of a box of matches!

These units rendered valuable service under actual military operation in France. Some of them were damaged by shell-fire and some members of the Sanitary Corps were wounded while operating the units near the firing line.

Acknowledgement must be made of our appreciation of the co-operation extended by the surgeon-general's office, the Sanitary Corps, the Engineer Depot, and particularly to the following officers:—Col. F. F. Longley, Lt.-Col. Edward Bartow, Major H. McC. Yost, Capt. Morris Scharff, Capt. Gerald W. Knight, Capt. W. F. Wells, Capt. J. J. Newman, Lt. A. H. Wagner, Lt. H. H. Scott and Lt. T. W. Smith.

Without the suggestions and co-operation of M. F. Tiernan, and C. F. Wallace, of our organization, these units could not have been constructed, and special thanks are due to two members of our staff until recently in service in France, Capt. A. R. Murphy, who materially contributed to the development of the first unit in the tests at Maplewood, N.J., and Capt. R. V. Donnelly, who was in charge of their construction at Camden, N.J. Thanks are also due to the engineers of the Roberts Filter Mfg. Co. for their special co-operation.

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RIVETED JOINTS FOR PENSTOCKS

IN many of the more recent hydro-electric developments of large capacity, it has been necessary to use steel penstocks of large diameters under high heads, and in order to keep the thickness of metal within reasonable limits, so that the work can be handled by the ordinary equipment of structural shops, it is quite essential to use the most efficient types of joints.

The article by H. A. Babcock and J. R. Montague in this issue assembles information on the design of these heavier joints which is not readily obtained in text books, and which should, therefore, be of value to designers who have to handle problems of the nature discussed.

The strength of a joint depends upon three main factors, namely, tension in the plate, shear on the rivets and bearing on the rivets; and as in the heavier types of joints one finds several combinations of these three factors, these *combinations* must be carefully considered when solving for the maximum efficiency.

CONTRACT FORMS

CONTRACT forms and specifications have been the subject of special study by engineers and architects for a number of years. The American Institute of Architects has developed the Standard Documents; the American Railway Engineering Association has adopted a uniform general contract form; a special committee of the American Society of Civil Engineers has the subject now under consideration. To date, the only voice which the general contractor, who is the man most vitally interested in contract forms, has had in the matter, has been either on the invitation of some one of the committees of these associations, as an ineffectual protester in some local exchanges, or as the victim of circumstances on an individual contract. What he has said before the committees of engineers and architects has doubtless had some effect on the final results, and at least has put the contractor's position on file. What he has said in his local exchange or in the secluded recesses of his own office, will doubtless never be allowed publication. Both the Association of Canadian Building and Construction Industries and the Associated General Contractors of America now propose to make the general contractor's position clear and effective on the subject of contracts. They intend to make a careful study of existing forms, both good and bad, of every kind, and in co-operation with the engineers and the architects, to eliminate unfair practices and to establish clear, definite and equitable clauses in contracts under which general contractors of recognized standing will work.

OWEN SOUND'S INTERSWITCHING PROBLEM

OWEN SOUND lies in the valley of, and at the mouth of, the Sydenham River. The harbor was formed by widening and deepening the river. The mouth of the river at the entrance has a width of 295 ft.; the main harbor has an average width of 350 ft. The upper or narrow portion, near the Tenth Street bridge, is only about 100 ft. wide. The town is served by branches of the Canadian Pacific and Grand Trunk railways. The yards and stations of each immediately adjoin the harbor, the Grand Trunk being on the west and the Canadian Pacific on the east. There is no connection between them. Each railway enters the town through an industrial district which it well serves. Neither road, in any place, traverses a residential or business district or crosses an important street. The station of each is within about one-half mile of the business centre of the town. But there is no connection between the two railways, thus preventing the interswitching of either passenger or freight cars.

A number of methods of interswitching have been proposed, and W. F. Tye, consulting engineer, Montreal, was recently asked to investigate them. Mr. Tye has reported that the best method, from a strictly railway point of view, would be to permit the Grand Trunk to follow First Avenue West to a point between Ninth and Tenth Streets, cross the Sydenham River at the bend, switch back at a point on First Avenue East just south of Ninth Street, and run back to the Canadian Pacific Railway on First Avenue East. "As such a route would be highly objectionable to the residents of First Avenue West," says Mr. Tye, "I did not seriously consider it."

Of the other suggestions, he reports that only three appeared to be worthy of detailed examination:—

1.—Crossing the river at its mouth.

2.—Crossing the harbor at Tenth Street traffic bridge and switching back on First Avenue East.

3.—Electrical switching.

Of these three Mr. Tye recommends the second method despite the fact that it would bring steam locomotives into the mercantile districts, passing and shunting directly behind a number of the best shops, with all the attendant disadvantage of noise, soot, dirt, smoke, etc. They would also pass within 300 ft. of some of the best residences of First Avenue West. Moreover, this method would involve considerable shunting across busy Tenth Street at the east end of the bridge. The switch would be located immediately to the south of Tenth Street, and each train passing between the two roads in either direction would have to cross Tenth Street twice.

With all these disadvantages, it is indeed unfortunate for Owen Sound that the second method is the only one that Mr. Tye can recommend from an economical point of view.

The only objection from an engineering standpoint that Mr. Tye takes to crossing the river at its mouth, is that for a considerable distance the interswitching trains must back up, and that this is objectionable in the winter. Exactly how insuperable this difficulty is, Mr. Tye does not say. He also refers to interference with navigation, but this could be obviated, at considerable expense, he intimates, by the construction of a bascule bridge instead of a swing bridge. "This route is economically justifiable as a whole," states Mr. Tye, but he estimates that the railways would lose about $1,500 a year as a result, at full switching charges. This crossing, however, has the decided advantage that it confines the railways entirely to the industrial districts, where they belong, keeping them out of the mercantile and residential sections.

Mr. Tye frankly makes it plain that he does not try to place any monetary value upon this advantage, which is a matter of civic convenience, esthetics and town planning. But the citizens of Owen Sound, expecting their city to grow and to become better able in the future to support, even at an annual loss, enterprises that are of benefit to the city as a whole, will no doubt take these items into serious consideration. Mr. Tye evidently expects them to do so, inasmuch as he carefully points out the very great disadvantages —from a community standpoint—of the plan that he recommends mainly for economical reasons.

Would it not be well for the officials of Owen Sound, before finally deciding this very vital question, to consult Thomas Adams, the town planning adviser to the Dominion government, or some other town-planning authority, regarding possible disastrous effects that any one of the various proposed plans might have upon the future growth, beauty, comfort, assessed valuation and general welfare of their city?

ENGINEERING INSTITUTE ELECTIONS

AT a meeting of the Engineering Institute of Canada held July 22nd in Montreal, the following elections and transfers were announced:—

Members.—H. W. Buck, Hewlett, N.Y.; A. R. Chambers, New Glasgow; G. P. Cole, Montreal; F. O. White, Temiskaming.

Associate Members.—J. R. Black, Sault Ste. Marie; J. L. Charles, Toronto; F. W. Clark, Niagara Falls; G. A. Colhoun, Hamilton; C. D. Dean, Toronto; L. L. Jacobs, Sault Ste. Marie; A. C. Loudon, Montreal; H. D. Maccaulay, St. John, N.B.; J. A. H. Marchand, Three Rivers; E. S. Martindale, Ottawa; H. R. McClymont, Toronto; C. R. McColl, Sandwich, Ont.; W. L. McFaul, Sault Ste. Marie; H. B. Pickings, Halifax; F. L. Richardson, St. John, N.B.; K. G. Ross, Sault Ste. Marie; H. N. Skolfield, New Glasgow; Francis Stidwill, Cornwall; C. W. Stokes, Montreal; G. M. Tripp, Victoria; W. D. Walcott, Toronto; C. S. Whitney, Niagara Falls; D. S. Wickwire, Halifax.

Juniors.—P. B. Buckley, Montreal; C. R. McCort, Montreal; R. C. Moore, Halifax; W. H. S. Richardson, Belleville; S. O. Roberts, Ottawa; B. N. Simpson, Toronto; G. O. Vogan, Toronto; C. O. Whitman, Sault Ste. Marie.

Transferred, Associate Members to Members.—A. E. Caddy, Campbellford, Ont.; J. A. DeCew, Mount Vernon, N.Y.; L. B. Elliot, Edmonton; B. M. Hill, Fredericton; S. B. Johnson, Ottawa; N. B. McLean, Ottawa; G. G. Murdoch, St. John, N.B.; A. V. Redmond, Winnipeg.

Transferred, Juniors to Associate Members.—L. C. Dupuis, Levis; J. A. Keefer, Victoria; A. M. Kirkpatrick, Ottawa; A. G. McLerie, Toronto; J. N. Stinson, Ottawa; L. W. Wynne-Roberts, Toronto.

Transferred, Students to Associate Members.—C. R. Avery, Toronto; J. H. A. E. Drolet, Quebec; J. E. Heroux, Quebec; R. P. Johnson, Niagara Falls; P. C. Kirkpatrick, Ottawa; C. C. Lindsay, Quebec; J. E. Ratz, Ottawa; W. E. Stephens, London; A. C. Wright, Ottawa.

Transferred, Students to Juniors.—R. D. Galbraith, Toronto; W. B. Redman, Toronto.

PERSONALS

JAMES, LOUDON & HERTZBERG, LTD., consulting engineers, Toronto, have been asked by the council of Chatham, Ont., to investigate the city's water supply and to report upon proposed improvements.

JOHN HEPINSTALL, of St. Thomas, Ont., who has been in Washington, D.C., engaged in special work for the U.S. Navy, is reported to have been appointed supervising engineer of design at the Charleston, W. Va., naval base.

D. A. R. MCCANNEL, who has been acting city engineer of Regina since April, 1917, can now drop the "acting" from his title, as the city council have appointed him as permanent head of the city's engineering staff, which he joined in 1911.

HON. FRANK CARVELL, who last week resigned as Minister of Public Works, has been appointed chairman of the Board of Railway Commissioners for Canada, succeeding SIR HENRY L. DRAYTON, who resigned to accept the post of Finance Minister in the Dominion cabinet.

WILLIAM SNAITH, office engineer for the Hydro-Electric Power Commission of Ontario on the construction of the Chippawa-Queenston power canal, has resigned to accept a position as principal assistant engineer on the staff of Frank Barber and R. O. Wynne-Roberts, consulting engineers, Toronto.

PROF. E. G. MATHESON, assistant engineer on the staff of the University of British Columbia, and acting head of the Department of Civil Engineering, has been appointed, under A. D. Swan, consulting engineer, to take charge of the surveys and borings in connection with the contemplated development of Vancouver Harbor.

CAPT. R. G. SNEATH, formerly a member of the Welland Canal engineering staff, has returned from overseas and has joined the radial railway department of the Hydro-Electric Power Commission of Ontario. Capt. Sneath graduated in civil and sanitary engineering at the University of Toronto in 1911 and 1912. He went overseas in the spring of 1916 with the 4th Division, and took part in a large number of important engagements.

LT.-COL. WILLIAM G. MACKENDRICK, president of the Warren Bituminous Paving Co. of Ontario, and formerly director of roads for the Fifth British Army, has been appointed an officer of the Legion of Honor by the French government. Col. MacKendrick rendered very valuable services while at the front, saving hundreds of thousands of dollars in road construction for the allied armies. For this work the British government conferred upon him the Distinguished Service Order and the Order of the British Empire.

R. R. SHAFTER, who is well known among Canadian engineers and contractors, has been appointed manager of the New York district office of the Traylor Engineering and Manufacturing Co., of Allentown, Pa. Mr. Shafter's territory will include New York State, New England and Eastern Canada. Before the war Mr. Shafter travelled throughout Eastern Canada as the Traylor Co.'s representative, but during the war he was general superintendent for the Traylor Shipbuilding Corporation, Philadelphia. Under Mr. Shafter's management, that corporation completed more 3,500-ton cargo carriers within two years than did any other shipyard on the Atlantic and Gulf coasts.

MAJOR A. J. MCPHERSON, formerly chairman of the Local Government Board of the Province of Saskatchewan and at one time deputy minister of public works of that province, has been appointed consulting engineer to the Saskatchewan Bureau of Public Health, succeeding the late T. Aird Murray. Major McPherson will also act as consulting engineer to the Local Government Board. He returned not long ago from France, where he served throughout the years 1917 and 1918 with the Canadian Engineers, at first as a field engineer on roads and defences, and later as second in command of the 11th Battalion. Major McPherson graduated in 1893 at the University of Toronto, Faculty of Applied Science and Engineering.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand or proposed, contracts awarded, changes in staffs, etc.

ADDITIONAL TENDERS PENDING

Not Including Those Reported in This Issue

Further information may be had from the issues of *The Canadian Engineer*, to which reference is made.

PLACE OF WORK	TENDERS CLOSE	ISSUE OF	PAGE
Anse aux Gascons, Que., wharf.	Aug. 14.	July 31.	42
Bridgeville, N.S., school	Aug. 30.	July 31.	41
Chicoutimi, Que., station	Aug. 9.	July 24.	46
Cornwall, Ont., wharf	Aug. 12.	July 31.	44
Halifax, N.S., schools	Aug. 30.	July 31.	41
Indian Head, Sask., office building	Aug. 12.	July 31.	41
Odessa, Ont., bridgework	Aug. 8.	July 31.	44
Orangeville, Ont., culverts, bridges and abutments	Aug. 11.	July 31.	39
Ottawa, Ont., pumps, engines, etc.	Aug 30.	July 31.	44
Saskatoon, Sask., steel and concrete bridges	Aug. 12.	July 31.	39
Saskatoon, Sask., turbo-generator	Sept. 23.	July 24.	44
Strathroy, Ont., cannery buildings	Aug. 8.	July 31.	42
Toronto, Ont., grading and road construction	Aug. 18.	July 31.	40
Toronto, Ont., highway structures	Aug. 19.	July 31.	46
Toronto, Ont., pavements, curbs and sidewalks	Aug. 11.	July 31.	40
Toronto, Ont., railway ties	Aug. 25.	July 31.	46
Truro, N.S., girls' home	Aug. 8.	July 31.	42
Walkerville, Ont., pumping station	Aug 12.	July 31.	40
Winnipeg, Man., water recorder	Sept. 1.	July 31.	46

BRIDGES, ROADS AND STREETS

Amherstburg, Ont.—Contract has been awarded by the town council for construction of Silex stone walks on St. Arnaud, Laird, Alma and William Sts., to Henry Robidoux, 15.25 cents per ft. Rejected tenders from Pettypiece, Ltd., 20 cents per ft.; C. M. Ferriss, 17 cents per ft. W. A. McCormick, town clerk.

Brantford, Ont.—The city council contemplate building a concrete pavement on West St. to connect with the country road to Mount Hope Cemetery.

Brechin, Ont.—Contract was awarded by the committees from Victoria and Ontario counties for construction of a reinforced concrete bridge to Mr. Kehoe, Brechin. Contract price, $2,125 (less the price of the steel). Chairman Thompson, Victoria county.

Chilliwack, B.C.—The Yale road at Chilliwack will be paved this summer, utilizing the present macadam pavement as a base. J. W. Blackman, city engineer, New Westminster, B.C.

Chilliwack, B.C.—Arrangements have been made between the city council and the provincial department of works to proceed with construction of an 18-ft. pavement this year on the Westminster-Yale road.

Crowland, Ont.—Contract has been awarded by the township council for construction of concrete pavements on South Main and Ontario St. to Somerville and Dilworth, Welland, Ont. Contract price, $1,845. H. L. Pratt, clerk.

Douro, Ont.—The townships of North Monaghan, Otonabee and Asphodel have adopted the good roads scheme and will proceed with construction at an early date.

Galt, Ont.—The board of works has announced its intention to commence construction of pavement on Park Ave. Work will start immediately. Chairman McKellar.

Halifax, N.S.—The board of works will pave the following streets in the order mentioned: Kempt Rd., Livingston to Macara; Robie St., Macara to Quinpool Rd.; Bell Rd., Quinpool Rd. to Sackville St.; Coburg Rd., Robie to Oxford; Agricola St., Cunard to Almon; Morris St., Water to South Park; Spring Garden Rd., Tower Rd. to Robie; Gottingen St., Gerrish to Young; Sackville St., Barrington to South Park; Grafton St., Spring Garden Rd. to Blowers; Argyle St., Blowers to Jacob; Prince St., Water to Argyle; Cornwallis St., Brunswick to Gottingen; Brunswick St., Sackville to North; Jacob St., Argyle to Brunswick; Quinpool Rd., Willow Tree to Arm Bridge; Cunard St., Gottingen to Robie; North St., Barrington to Robie; Salter St., Water to Hollis; Granville St., Sackville to Salter; Buckingham St., Barrington to Brunswick; Windsor St., Quinpool Rd. to Cunard; Hollis and South Sts. will take precedence as soon as they are in shape to be paved. F. W. W. Doane, city engineer.

Mimico, Ont.—The Toronto-Hamilton Highway Commission have opened their new reinforced concrete bridge over Mimico Creek.

Montreal, Que.—The commissioners of the city of Montreal have awarded contract for block and asphaltic pavement on Redpath St. to the city department of works. A. E. Doucet, director.

Montreal, Que.—No tenders were received by the commissioners of the city of Montreal for the demolition of the old and construction of a new wooden bridge over the Aqueduct at Woodland Ave. New tenders will soon be called. A. E. Doucet, director.

Montreal, Que.—Sidewalks will be constructed on the following streets: Northcliffe Ave., both sides, from Sherbrooke to Notre Dame de Grace Ave., cost $15,184; Wilson Ave., from Sherbrooke to the C.P.R. tracks, cost $4,096; Old Orchard Ave., from Church to Monkland, cost $4,600; Ste. Marguerite, from St. Antoine to Richelieu, cost $880; Ste. Emelie St., both sides, from de Courcelles to Beaudoin St., cost $7,084; Sir George Etienne Cartier, both sides, from Emelie southwards, cost $1,300; Maria, from St. Augustin to Ste Emelie, cost $2,800; both sides of Lenoir St., from St. James to St. Antoine St., cost $3,014; Desnoyers St., along its entire length, cost $6,853; both sides of Walnut St., for its entire length, cost $4,273. Rene Bauset, city clerk.

Niagara Falls, Ont.—Contract has been awarded by the city council for construction of concrete pavements, curbs and gutters to the works department, city of Niagara Falls. D. T. Black, city engineer.

Odessa, Ont.—Tenders will be received by the department of highways, Toronto, until 12 o'clock noon, August 8th, for construction of concrete abutments, concrete roadway and sidewalk floors. Plans, etc., at the offices of the resident engineer, Napanee and city engineer, Kingston. W. A. McLean, deputy minister.

Orangeville, Ont.—It is proposed to erect a new bridge in place of the present wooden structure over the creek at Mill St. as a soldiers' memorial.

Owen Sound, Ont.—Contract has been awarded by the town council to the Warren Bituminous Paving Co. for construction of pavements as follows: On macadam base, $2.47; on tar macadam base, $2.37, and on new macadam base, $3.24. To Curren and Clement, Orillia, curb and gutter, $1.15; gutter only, 55 cents; catch basins, $40; 8-in. sewers, 60 cents. D. H. Fleming, town engineer.

Pickering, Ont.—Tenders will be received until 12 o'clock noon, August 19th, for construction of concrete abutments, concrete roadway and sidewalk floors for highway bridge over Duffin's Creek, village of Pickering. (Official advertisement in this issue.) W. A. McLean, deputy minister of highways, Toronto.

Regina, Sask.—Tenders will be received until 4.30 o'clock, August 12th, by the department of public highways, Regina, for construction of a reinforced concrete bridge over Wascana Creek. H. S. Carpenter, deputy minister.

Saskatoon, Sask.—The provincial government has commenced work on the Porcupine roads. The section between Prairie River and Copeaus will be under the direction of Engineer Gray. Bridges, under Engineer Linton.

Sherbrooke, Que.—It is expected that work will be commenced immediately on construction of the Sherbrooke-Montreal highway. The width of this road is to be from 22 to 24 ft., and all curves must have a radius of at least 300 ft. J. H. Lemay, M.L.A., Sherbrooke county.

Simcoe, Ont.—Tenders will be received until 6 p.m., August 11th, by the town council for concrete curbs, gutter sewers and tarvia macadam pavement. G. R. Marston, town engineer; W. C. McCall, town clerk.

St. Armand Station, Que.—Tenders will be received until noon, August 11th, by the Good Roads Department, Quebec, for gravelling roads in Parish of St. Armand West. George Bradley, secretary-treasurer, St. Armand Station, Que.

Toronto, Ont.—The department of works, city hall, will pave the following streets in the east end this summer: Ingham, Millbrook, Gerrard bridge, Hastings, Orchard Park. Arundel and Silver Birch Aves. Sidewalks to be laid along the following streets: Cavell, Coleman, Ashbridge, Danforth, Morten, Oakcrest, Silver Birch, Glenmore, Walpole, Beachview, Ellerbeck, Drayton and Jones Aves. R C. Harris, commissioner.

Toronto, Ont.—Mayor Church has requested Commissioner R. C. Harris, of the works department, to bring in a recommendation for paving York St., south from Queen St., and Front St., between York and Simcoe St.

Victoria, B.C.—Contract has been awarded by the department of public works, Victoria, for the first section, 17,300 lin. ft., of the provincial highway, near South Port Mann post-office, to H. P. Peterson, Vancouver. Contract price, $115,000. Hon. J. H. King, minister.

Victoria, B.C.—Contract for regrading and paving about three and a quarter miles of the Pacific highway, south from the Westminster bridge, Delta district, has been awarded by the department of public works, Victoria, to the H. P Peterson Construction Co., Ltd., 704 Birks Building, Vancouver. Contract price, $88,000. Work to be completed November 30th, 1919. A. E. Foreman, engineer.

Welland, Ont.—The Welland county council has awarded contracts for construction of roads as follows: Bethel Rd., division 16, 2.5 mls., to John Pirson, tender, $5,544 per ml.; Ridgeway, to E. B. Begy, concrete, length, 0.5 mls., tender, $19,500; Forks Rd., from Marshville to Port Colborne, 10 mls., water-bound macadam, to John Pirson, tender, $9,978.20 per ml. Rejected tenders, Ridgeway Rd., concrete construction, McCrae, Campaigne and Cook, $22,294; Gardner and Thomas, $24,135; Somerville and Dilworth, $22,220; tar-bound macadam surface, McRae, Campaigne and Cook, $11,072. Forks Rd., water-bound macadam, McRae, Campaigne and Cook, $12,672.45 per ml.; C. E. Kilmer, $19,370 per ml. Bituminous penetration paving on macadam road, McRae, Campaigne and Cook, no 3-year guarantee, $18.774 per ml.; with guarantee, $20,463.60 per ml.

Windsor, Ont.—The project of connecting the cities of Detroit and Windsor by means of a bridge, with 140 ft. clearance above the river, is being planned by Dr. J. A. L. Waddell, Kansas City and New York city.

Winnipeg, Man.—St. Andrew's municipality proposes to construct one hundred and forty miles of gravel roads to Winnipeg Beach. Estimated cost, $535,000.

Winnipeg, Man.—Tenders will be received until noon, August 9th, by the municipality of St. Francois Xavier for gravelling of 12 miles of Portage highway. E. Scott Shields, secretary-treasurer.

WATER, SEWAGE AND REFUSE

Burlington, Ont.—Contract has been awarded by the town council for construction of sewers on Caroline, Clarke North, Clark South, Green, St. Paul, Guelph, New, Hagar and Ontario Sts. to D. O. Johnson for $18,788.75. Rejected tender, Lorenzo and Liberio, $15,360.45. Deputy reeve, Wm. Bridgman.

Chatham, Ont.—The water board contemplate additions and improvements to the water supply. It is understood that the board is waiting for a report of the Hydro engineer before calling on a filtration expert. The present plant will

City Engineer Wanted

For the City of St. Thomas, Ont. Must be competent to take charge of all street improvements and other municipal engineering work, including that of the water works department. Applications to be addressed to the undersigned and to state age, experience and salary expected, and to enclose references.

E. A. HORTON, Mayor.

St. Thomas, Ont., August 6th, 1919. 319

TENDERS FOR BRIDGES

Sealed tenders, plainly marked as to contents, addressed to the undersigned, will be received up to 2 p.m. on Monday, August the 11th, 1919, for the construction of the following reinforced cement concrete culverts, bridges and abutments:—

(1) Located in the County of Dufferin—
- 1 culvert 4-foot span.
- 4 culverts 6-foot "
- 1 culvert 8-foot "
- 7 bridges 10-foot "
- 2 bridges 12-foot "
- 1 bridge 14-foot "
- 1 bridge 16-foot "
- 1 bridge 20-foot "
- 1 bridge 22-foot "
- 3 bridges 24-foot "

(2) Located in the Township of Albion—
- 1 pair of abutments for a 55-foot steel truss.
- 1 " " " " " 48-foot " "

(3) Located in the Township of Toronto Gore—
- 1 bridge 32-foot span.

(4) Located in the Township of Toronto—
- 1 bridge 12-foot span.

Plans and specifications may be seen and forms of tender and all information obtained at the office of the undersigned. The lowest or any tender not necessarily accepted.

WHEELOCK & CHRISTIE,
Civil Engineers,
Orangeville, Ont. 314

probably be remodelled, a new plant constructed and liquid chlorine used in the filtered water.

Galt, Ont.—Plans are being prepared for extension of water works system on certain streets. Town electrician Scott.

Moncton, N.B.—The city council has decided to extend the sewerage system on Cornell St., from Church to Henry St.

Oshawa, Ont.—The works committee has recommended that the contract be awarded for construction of sewer for the north part of the town to the McKnight Construction Co., Toronto. Contract price, $27,880. Other tender, Webster Construction Co., London, $33,661.40. These tenders did not include the 18 manholes and ladders, which will be provided by the town.

Regina, Sask.—The works department will commence construction of water works extensions about the end of the month. Work to be rushed to completion.

Sarnia, Ont.—Thos. Grace, who received the contract for installing a new intake pipe at the Point Edward water works, has commenced work. The derrick scow and dredge will arrive soon.

St. John, N.B.—The city council will extend the water and sewerage systems along Hawthorne Ave. Estimated cost, $14,000.

Wingham, Ont.—Contract has been awarded for construction of sewers and water mains to T. J. McLean ,and Co. Contract price, $4,500.

RAILWAYS

Arnprior, Ont.—The Galetta Power Co. will soon construct the new line from Galetta to Carp. Poles will be erected and the line completed at once. Mr. Locher, electrical engineer.

Calgary, Alta.—The commissioners of the city of Calgary contemplate extending the Bridgeland street car loop to serve a much larger area of that section. Superintendent McCauley.

Edmonton, Alta.—The Yukon Development league plans to connect Edmonton with Dawson by the extension of the E.D. and B.C. Ry. 1,200 miles through the Peace River country into the Liard district, along Finlayson River into the Yukon. Frank Lowe, president.

Fenelon Falls, Ont.—The local council will urge the Hydro-Electric Power Commission to extend the electric radial railway from Port Perry to Lindsay and thence northward through Victoria county.

Port Arthur, Ont.—The Canadian National Railways will construct an electric sub-station in connection with the new workhouse of the Port Arthur elevator.

Fort William, Ont.—The Canadian National Railways will widen the right-of-way between Empire Ave. and Frederica St., through West Fort William.

Galt, Ont.—At a meeting of civic and board of trade representatives from municipalities extending from Elmira to Hamilton, a resolution was passed requesting the Hydro-electric commission to proceed at once with reports on construction and operation of an electric railway to serve the district between Elmira, Galt, Hamilton and Guelph, also that the Hydro-electric commission be authorized by order in council to proceed at once with the construction of the Toronto to Hamilton electric railway. Another resolution set forth that sixty-two municipalities in Ontario had carried by-laws for the construction of Hydro-electric railways, and urged that the building of these railways be authorized by the provincial government by order in council. S. E. Charlton, Galt. D. Gross, mayor, Kitchener.

Halifax, N.S.—The city council will request the street railway to proceed with construction of a new line along Cogswell St. F. W. W. Doane, city engineer.

Halifax, N.S.—The Inverness Railway and Coal Co. will probably be purchased by the government and operated as part of the Canadian National Railways system.

Ottawa, Ont.—The city council has authorized the construction by the Ottawa Electric Railway Co. of a loop for the St. Patrick cars on Cobourg, Murray and Charlotte Sts.

Ottawa, Ont.—Tenders will be received until August 11th by the secretary, department of public works, Ontario, for electric wiring and fixtures required in connection with the alterations to the Normal and Model Schools, Ottawa. H. F. McNaughton, secretary.

Prince Albert, Sask.—The Canadian National Railways will start construction work immediately upon the new line from Prince Albert north to Paddock Wood. Andrew Knox, M.P., Prince Albert.

Sydney Mines, N.S.—A deputation from district No. 4 will request the Cape Breton Electric Co. to extend their lines a further 10 miles. Councillor McKeigan.

Toronto, Ont.—Commissioners Harris and Bradshaw are preparing a report on an expenditure of $5,000,000 for new civic street cars and extensions to the present civic system. T. L. Church, mayor.

Toronto, Ont.—It is expected that the new tracks on Pape Ave. will be laid very soon. The steel is in transit and is to be transferred to the Toronto Railway Co. upon arrival. R. C. Harris, commissioner of works, Toronto.

Windsor, Ont.—The city council has served notice of intention to purchase upon the officials of the Sandwich, Windsor and Amherstburg electric railway upon the expiration of its franchise in 1922. Mayor Winter, Windsor.

Woodstock, Ont.—Construction work on the Ingersoll-Woodstock section of the new provincial highway will not be commenced this year. It is stated that, owing to the Ingersoll-Thames Valley electric railway running directly along the route of the highway, some agreement will have to be made between the government and the railway.

FACTORIES AND LARGE BUILDINGS

Arnprior, Ont.—The Ottawa Valley Amusement Co. have awarded contract for construction of a new, modern theatre to be built on John St.

Belleville, Ont.—The Tivani Steel Co., Ltd., contemplate construction of a plant to consist of electric furnaces, rolling mills, merchant bar milling and open-hearth furnaces. Estimated cost, $5,000,000. A. P. Gillies, Seattle, Wash. Plans are about completed for a similar plant in Vancouver.

Calgary, Alta.—The Alberta Stockyards Co. has commenced construction of a modern office building. Additional new pens, pavements and sewers will be constructed this fall. Estimated cost, $300,000. J. M. Cameron, president.

Edmonton, Alta.—Plans are being prepared for the addition of a new wing to be built on the Royal Alexandra Hospital.

Edmonton, Alta.—A new dairy building and an addition to the manufacturers' building will probably be erected this fall. W. J. Stark, manager, Edmonton exhibition.

Galt, Ont.—The Imperial Bank has awarded contract for reconstruction and enlargement of their present building at the corner of main and Water Sts., to George Thomas.

Galt, Ont.—Contract has been let for construction of a new tin smelting plant. One smelter is to be erected at present, to be followed by additions in the near future.

Guelph, Ont.—A new, artificial-ice skating rink is proposed. Construction will probably be commenced immediately to insure completion in time for winter season.

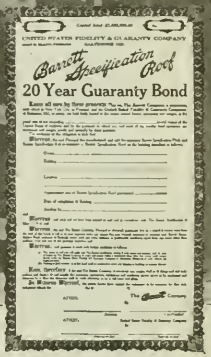
Guelph, Ont.—The Guelph housing commission has awarded contracts for construction of ten houses to the Ontario Co-operative Building Society, and also to Shepherd and Hicks.

Halifax, N.S.—Tenders will be received until noon, August 12th, by the department of public works for altera-

Barrett Specification Roofs

This roof carries the 20-year bond.

Barrett Specification 20-Year Roof on the Mercury Mills, Hamilton, Ont. Engineer and Architect—C. T. Main, Boston, Mass. Roofers—Dennis and Jocelyn, Hamilton, Ont.


UNITED STATES FIDELITY & GUARANTY COMPANY

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This is the bond that guarantees your roof for 20 years.

Cover Your Investment with a 20-Year Guaranty Bond—

Every one knows that a structure of concrete and steel will endure for a generation and more.

But how about the roof that covers the structure?

Frequently that is not only an unknown quantity but a *liability* rather than an *asset*.

It is a short-sighted and costly policy to put a *poor* roof on a *good* building.

As one of the oldest and largest manufacturers of materials used in constructing roofs, we have done our part to make *all* roofs *good* roofs.

Years ago, for that reason, we induced the leading architects and engineers to unite in the adoption of The Barrett Specification as a satisfactory *standard specification*.

Now we go a step further by sending our Inspectors to check up on the construction, and if they find that The Barrett Specification has been properly complied with, we will, without charge, issue a 20-Year Guaranty Bond *exempting the owner from all further expense for repairs or up-keep on that roof for twenty years.*

This service may be had on all roofs of fifty squares or larger in all towns of 25,000 population or more and in smaller places *where our Inspection Service is available.*

Our guaranty is a real Surety Bond issued by one of the largest Surety Companies in the world. Our only requirements are that The Barrett Specification dated May 1, 1916, shall be strictly followed and that the roofing contractor shall be approved by us and his work subject to our inspection.

Thus, in spite of the fact that we do not build roofs ourselves, we are put in a position where we can guarantee the delivery of the long years of service which these roofs are capable of giving.

A copy of The Barrett 20-Year Specification, with roofing diagrams, sent free on request.

The Barrett Company LIMITED

Montreal Toronto Winnipeg Vancouver
St. John, N.B. Halifax, N.S. Sydney, N.S.

tions to buildings at Camp Hill Military Hospital. Plans, etc., at office of chief architect, Ottawa; superintendent of Dominion buildings, Halifax, and overseer of Dominion buildings, central post-office, Montreal. R. C. Desrochers, secretary.

Hamilton, Ont.—The Carr Fastener Co., of Boston, will locate a Canadian branch here.

Hamilton, Ont.—Plans are being prepared for a five-story tailory to be erected on Hughson St. Firth Bros., Ltd., Hamilton, Ont.

Humboldt, Sask.—Contract for erection of a large addition to the round house, a new machine shop and boiler room has been awarded. Construction will start immediately.

Ingersoll, Ont.—Contract has been awarded by the town council for construction of an implement and machinery building to the Metal Shingle and Siding Co., Preston. Contract price, $1,194.

Innisfree, Alta.—Tenders will be received until noon, August 9th, by the board of trustees, Primrose School District No. 1949, for construction of school building. Donald A. Mackenzie, secretary-treasurer.

Londesboro, Ont.—Tenders will be received until August 12th by the Hullett township council for material and construction of a memorial hall in the village of Londesboro. John Fingland, clerk.

London, Ont.—Tenders will be received by the department of works, Ottawa, until 12 o'clock noon, August 15th, for construction of an Isolation hospital, T. B. pavilion, recreation building, storage, garage, etc., at Westminster psychopathic hospital, London, Ont. Plans, etc., at office of chief architect, Ottawa; superintendent of construction, Westminster military hospital, London; superintendent of Dominion buildings, Postal Station "F," Toronto, and overseer of Dominion buildings, Montreal, Que. R. C. Desrochers, secretary.

Moose Jaw, Sask.—Contract has been awarded by the public school board for construction of a cottage school on block 36—old city—to K. T. Karsgaard. Contract price, $2,-238.

Nacmine, Alta.—Tenders will be received until noon, August 9th, by the board of trustees, school district No. 3771, for construction of a frame school. Colin Campbell, secretary-treasurer.

New Liskeard, Ont.—Tenders will be received until August 11th, by the secretary, department of public works, Ontario, for construction of a barn at the Agricultural Farm. H. F. McNaughten, secretary.

New Westminster, B.C.—Contract was awarded by the school board to W. J. Sloan for four-room addition to Herbert Spencer school. Contract price, $10,000.

North Battleford, Sask.—Contract has been awarded to the B. M. Nesbitt Co., Ltd., for construction of a fifteen-stall roundhouse.

Ottawa, Ont.—Contract has been awarded for construction of new Loew Theatre at the corner of Bank and Queen St., to Bate, McMahon Co. Estimated cost, $500,000. J. A. Ewart.

Penticton, B.C.—The school board contemplate construction of a new, ten-room addition to the Ellis school. Estimated cost, $50,000.

Peterborough, Ont.—Tenders will be received until 12 o'clock noon, September 1st, by the board of education for construction of a public school. Architects, W. and W. R. L. Blackwell, Peterborough; consulting engineer, M. F. Thomas, Toronto. G. H. Thompson, secretary, Peterborough.

Port Arthur, Ont.—The Fort William council has authorized the drafting of a by-law to raise $75,000 as its share toward the cost of construction of a soldiers' memorial hall.

Port Arthur, Ont.—Contract has been awarded by the board of education to Lester Cain and J. E. Jenkinson for construction of a new 8-room school on Red River Road. Contract price, exclusive of plumbing, ventilation and heating, $88,000.

Port Arthur, Ont.—Contract has been awarded by the Canadian National Railways to Barnett-McQueen Cox, Port Arthur, for construction of a new workhouse with a capacity of 700,000 bushels for the Port Arthur elevator. The new structure will be of reinforced concrete.

Port Stanley, Ont.—Construction of a large hotel, with accommodation for two hundred, to be built on Invererie heights, has been proposed. The railway management contemplate building a dance hall and other improvements before winter sets in.

Regina, Sask.—The Sanitary Buildings, Ltd., contemplate construction of a warehouse and factory at corner of Scarth and Sixth St. Estimated cost, $25,000.

Regina, Sask.—Plans are being prepared for erection of a building on MacIntyre and Eleventh Ave. for Nay and James, Regina. Architects, Storey and Van Egmond. Estimated cost, $25,000.

Regina, Sask.—Contracts have been awarded for construction of schools at Theodore, Simpson and Nokomis to Waterman and Waterbury, Regina. Contract price, approximately $18,000 each.

Sandwich East Township, Ont.—The township council has decided to construct houses under the federal housing scheme and has appointed a housing commission.

Sarnia, Ont.—Contract has been awarded by the Lakeview Cemetery Co., Sarnia, for the construction of a mausoleum at Lakeview Cemetery, to D. W. Mitchell Construction Co., Toronto.

St. John, N.B.—The Canadian National Railways contemplate purchasing the Rockdale Hotel. Alterations and additions will probably be made.

Sydney, N.S.—Contract has been awarded for the construction of foundations and outside work for the new church being erected by the parish of the Holy Redeemer, Victoria Rd. to Rhodes, Curry and Co. Contract price, $100,000.

Toronto, Ont.—A rescue home for boys and girls will probably be constructed in Toronto. Estimated cost, $1,000,-000. Rev. David S. Kidd Byrne, Hamilton.

Toronto, Ont.—Tenders will be received until August 19th for the construction of a bank building on King St. West for the Merchants Bank of Canada. Darling and Pearson, architects.

Toronto, Ont.—The directorate of the Canadian National Exhibition propose to construct a new machinery hall and also a new manufacturers' building next year. Estimated cost, $1,000,000.

Toronto, Ont.—Tenders will be received until 4 p.m., August 27th, by the board of education, 155 College St., for all trades required in construction of three additional rooms to Carlton School, Davenport Rd., and also for the construction of new Norway primary school building, Kingston Rd. W. C. Wilkinson, secretary-treasurer.

Vancouver, B.C.—The Vancouver Theatre Co. will commence construction of a large, modern theatre this summer, to be completed early in the spring.

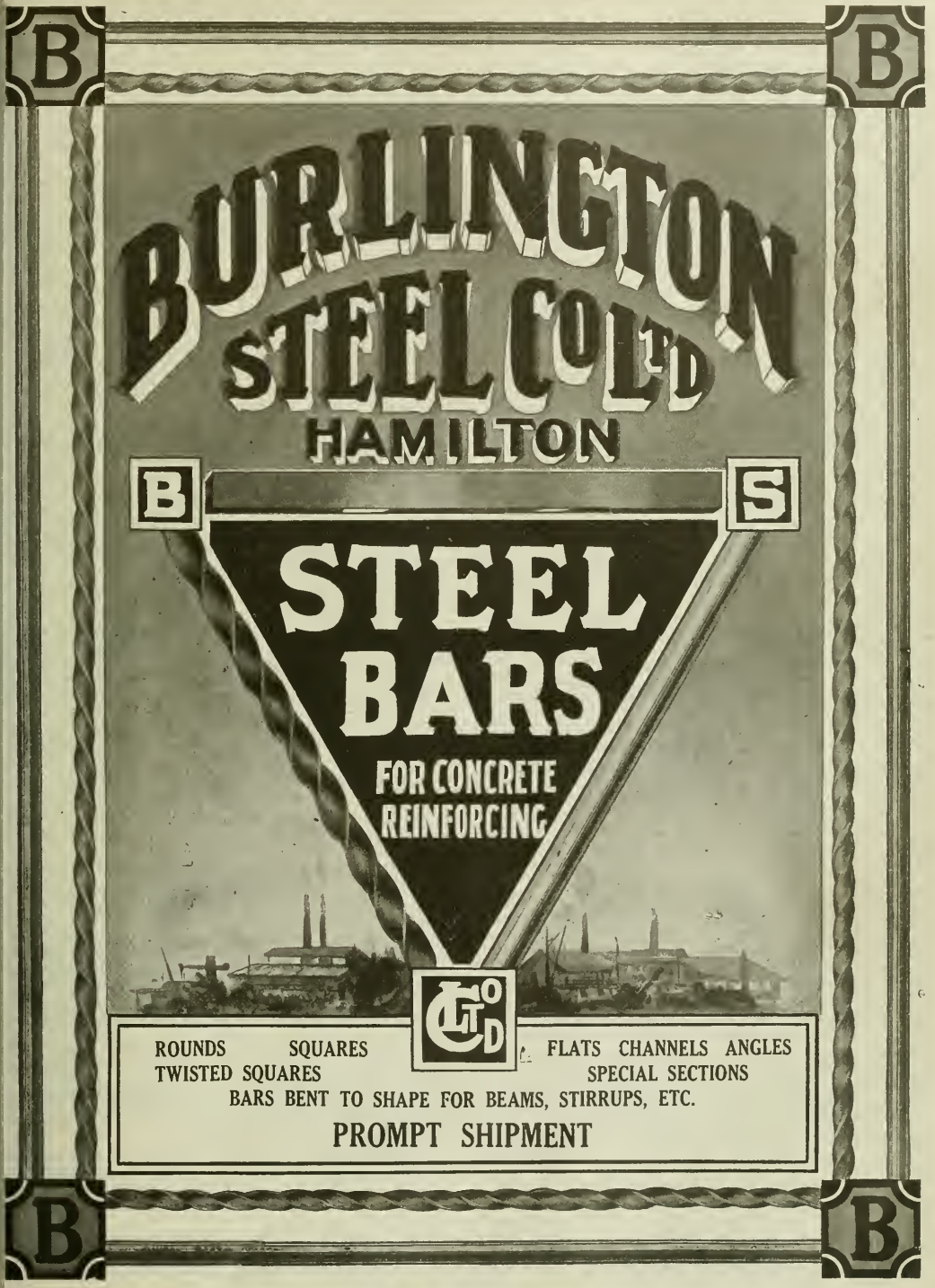
Vanderhoof, B.C.—Tenders will be received until noon, August 8th, by the department of public works, Victoria, B.C., for addition to school at Vanderhoof, Cariboo district, B.C. A. E. Foreman, engineer.

Windsor, Ont.—The Herendeen hotel will be renovated and enlarged by the addition of 50 rooms. Louis Kaplan, the new owner, will also build 8 stores on Wyandotte St.

Winnipeg, Man.—Plans are being prepared by Frank R. Evans, architect, for construction of a new modern fireproof fur warehouse and cold storage plant. R. S. Robinson, Louise St., Winnipeg.

Winnipeg, Man.—Contract has been let by the University of Saskatchewan, Saskatoon, for construction of new physics and engineering building. Estimated cost, $400,000.

Winnipeg, Man.—Tender has been awarded by the department of education, province of Manitoba, for the construction of schools at Barkfield and at Briston to John Waston. J. F. Greening, official trustee.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BARS BENT TO SHAPE FOR BEAMS, STIRRUPS, ETC.
PROMPT SHIPMENT

MISCELLANEOUS

Brampton, Ont.—Tenders will be received until 6 p.m., August 11th, by the town council for the construction of concrete retaining walls on Main St. South. C. M. Corkett, town clerk; W. M. Treadgold, town engineer.

Burlington, Ont.—The town council has awarded contract for road oil to the British-American Oil Co. Contract price, 9.5 cents per imperial gallon. Wm. Bridgman, deputy reeve.

Caledon Township, Ont.—The township of Caledon and Erin have decided to establish a municipal telephone system.

Chatham, Ont.—In this column, issue of July 24th, report was made of the intention of the city council to purchase an asphalt paving plant. This contract has been awarded to Heatherington and Berner Co., Indianapolis, Ind., $18,883.

Cookshire, Que.—Tenders will be received until August 12th by the monument committee of the town of Cookshire, for construction of a soldiers' memorial monument. O W. Rand, secretary.

Cornwall, Ont.—Tenders will be received until noon, August 19th, by the department of railways and canals, Ottawa, for rebuilding the north pier at the upper entrance to the Farran's Point canal. Plans, etc., at the office of the chief engineer, Ottawa, and the superintending engineer, Ottawa-St Lawrence canals, Cornwall, Ont. J. W. Pugsley, secretary.

Edmonton, Alta.—It is said that the federal government may proceed immediately with surveys with a view to large extensions of the irrigation systems throughout southern Alberta and Saskatchewan. Hon. A. C. McKay, minister of municipal affairs, Alberta.

Edmonton, Alta.—The provincial government will shortly call for tenders for construction of about 1,500 miles of rural telephone lines.

Fort William, Ont.—Engineers are preparing plans for the dredging of the Neebing River. F. H. Keefer.

Halifax, N.S.—Tenders will be received until noon, August 12th, by the department of public works, Ottawa, for construction of Orthopedic factory and for garage, both at Bellevue military hospital, Halifax. Plans, etc., at the office of chief architect, Ottawa; superintendent of military hospitals, Halifax, and overseer of Dominion buildings, central post-office, Montreal. R. C. Desrochers, secretary.

Kamloops, B.C.—Extensions to telephone and telegraph lines will be made in the following districts, 200 miles in the Kamloops and Okanagan districts, 22 miles from McKnight's to Adams Lake by Blucher Hall, 10 miles from Penantan Lake to Harper Ranch, Okanagan Falls to Meyers Flat, Slocan Junction to Slocan City, Windermere to Fairmont Springs. Estimated cost, $100,000. W. H. Stevens.

Kitchener, Ont.—The transportation committee of the board of trade will ask the board of works of the city council to co-operate in forming plans for a new subway under the railway tracks at King St. W. President Davidson.

Lorette, Man.—No tenders were received by the rural municipality of Lache, for grading and ditching north of sections 2 and 3-9-4 E., and on Dawson Rd., from lot 37 to 56. E. J. R. Arpin, secretary-treasurer.

North Lake, P.E.I.—Tenders will be received until noon, August 19th, by the department of public works, Ottawa, for construction of a boat harbor at North Lake. Plans, etc., at the offices of the district engineers at Charlottetown, P.E.I., Halifax, N.S., and at the post office, Elmira, P.E.I. R. C. Desrochers, secretary.

Port Stanley, Ont.—The department of public works contemplate dredging the harbor and constructing a new bridge at Port Stanley. District engineer Craig, Windsor, Ont.

Selkirk, Man.—Tenders will be received until noon, August 19th, by the department of public works, Ottawa, for construction of a crib wharf in front of the government fish hatchery, Dauphin River. Plans, etc., at the office of the district engineer, Winnipeg, Man., and post-office, Selkirk, Man. R. C. Desrochers, secretary.

Sherbrooke, Que.—Contract has been awarded to the Imperial Oil, Limited, by the city council for 180 tons of paving asphalt to be supplied in tank cars.

Simcoe, Ont.—Tenders will be received until 6 p.m., August 11th, by the town council for cast-iron pipe and sewer tile construction. G. R. Marston, town engineer; W. C. McCall, town clerk.

Stewart, B.C.—Tenders will be received until noon, August 20th, by the department of public works, Ottawa, for construction of a wharf. Plans, etc., at the office of district engineer, Prince Rupert, B.C., post offices at Vancouver and Stewart, B.C. R. C. Desrochers, secretary.

St. John, N.B.—Contract has been awarded to John Flood & Sons, for alterations and fittings in the new post office building.

St. John, N.B.—The city council has authorized construction of retaining walls along Hawthorne Ave. Estimated cost, $9,055.

Tisdale, Sask.—Tenders will be received until 4.30 o'clock, August 12th, by the department of public highways, Regina, for construction of two reinforced concrete abutments for bridge over Dog Hide Creek, at Tisdale, and for a bridge over Swan River north-east of Arran, both on the Can. Nat. Rys. H. S. Carpenter, deputy minister.

Toronto, Ont.—Tenders will be received by the board of control, Toronto, until noon, August 19th, for a revolving cantilever crane. T. L. Church, chairman.

Toronto, Ont.—Tenders will be received by the Canadian National Railways for 1,400,000 railway ties to be made and delivered between October 1st, 1919, and October 1st, 1920. 400,000 ties to be delivered on trans-continental, south of the St. Lawrence River, and 1,000,000 to be delivered on the Intercolonial, Halifax division. E. Langham, general purchasing agent, Toronto.

Toronto, Ont.—Tenders will be received until 4 p.m., August 11th, by the board of education, 155 College St., for moving a house in connection with Norway School, Kingston Rd., masonry work, Victoria school, smoke pipes, Kent school, midsummer repairs, including heating, ventilating, electric wiring, metal ceilings, cast iron grate bars, tile drains and electric motors in various schools. W. C. Wilkinson, secretary-treasurer.

Toronto, Ont.—Tenders will be received until noon, August 12th, by the board of control, city hall, for installation of sanitary conveniences in a number of dwelling houses. T. L. Church, chairman.

Toronto, Ont.—Tenders will be received until noon, August 19th, by the board of control, city of Toronto, for construction and delivery of 24-in. special castings. T. L. Church, chairman.

Toronto, Ont.—Tenders will be received until noon, August 25th, by the Canadian National Railways, Toronto, for 3,525,000 railway ties to be made and delivered between October 1st, 1919, and October 1st, 1920. Delivery to be made on the company lines as follows:—1,000,000 in British Columbia, 300,000 in Alberta, 1,500,000 between Winnipeg and O'Brien, 50,000 in Manitoba, 25,000 in Minnesota, 600,000 between Rainy River and Port Arthur, 50,000 on the Duluth, Winnipeg and Pacific lines in Minnesota. E. Langham, general purchasing agent, Canadian National Railways, Toronto.

Toronto, Ont.—The board of control has awarded contract for supply of 10 tank cars of asphalt for paving, to Imperial Oil, Ltd.

Wellesley Township, Ont.—The townships of Morning and Wellesley contemplate establishing a municipal telephone system serving both townships.

Winnipeg, Man.—Contract has been awarded by the Canadian National Railways, for grading and construction of culverts, mile 101.5 to mile 115.5, Thunderhill branch, to D. R. McDonald, Netherhill, Sask. H. A. Dixon, chief engineer.

Winnipeg, Man.—Tenders will be received until 3 p.m., August 11th, by the chairman, committee on Fire, Water, Light and Power, for repairing roof of six million gallon

PHILLIPS
VARNISHED CAMBRIC
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THE IDEAL CABLE FOR INSIDE USE
IN
POWER PLANTS

Single or Multiple Conductor
Braided or Lead Covered
Any Voltage up to 25000

PAPER INSULATED CABLES TO ANY SPECIFICATION

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RUBBER INSULATED WIRES WEATHERPROOF WIRES

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MONTREAL

Branch Offices:— Toronto Winnipeg Regina Calgary Vancouver

reservoir at McPhillips St. Pumping Station. C. J. Brown, city clerk, Winnipeg.

Winnipeg, Man.—Tenders will be received until 12 o'clock noon, August 8th, by the Commissioners, Greater Winnipeg Water District, 501 Tribune building, Winnipeg, for the purchase of two 2-6-0 Mogul locomotives, f.o.b. Paddington Transfer. (Official advertisement in this issue). R. D. Waugh, chairman.

Winnipeg, Man.—Tenders will be received until noon, August 15th, by the department of public works, Manitoba, for construction of approximately forty-two miles of drainage ditches in drainage district No. 2. Total excavation, approximately 314,000 cu. yds. (Official advertisement in this issue). George A. Grierson, minister.

Tenders Called For

TENDERS WANTED

PROVINCE OF MANITOBA
DEPARTMENT OF PUBLIC WORKS

TENDERS FOR DRAINS
DRAINAGE DISTRICT No. 2

Sealed tenders, endorsed "Tenders for Drains, Drainage District No. 2," will be received at the office of the undersigned up to noon of Friday, August 15th, 1919 (at which time and place same will be opened in public), for the construction of approximately forty-two miles of Drainage Ditches in Drainage District No. 2, the work comprising approximately 314,000 cubic yards of excavation.

Full information, plans, profiles, specifications and forms of tender may be had on application at the Office of the Engineer, Mr. H. A. Bowman, Parliament Buildings, Winnipeg.

Bids will be considered for the whole or any portion of the work.

All tenders must be accompanied by an accepted cheque, payable to the Minister of Public Works, for an amount equal to Five per cent. (5%) of the amount of the tender.

The cheques of the successful tenderer or tenderers will be forfeit to the Government should the tenderer decline to execute a contract in accordance with his tender, or, having executed same, fails to carry out the provisions thereof.

The lowest or any tender not necessarily accepted.

GEO. A. GRIERSON,
Minister of Public Works.

Winnipeg, Manitoba,
August 1st, 1919. 318

GREATER WINNIPEG WATER DISTRICT

TENDERS FOR WATER LEVEL RECORDER

Sealed tenders will be received by the undersigned up to noon on Monday, 1st September, 1919, for an apparatus which will indicate at the head office of the District the water level in the District's surge tank in St. Boniface.

Information for Bidders may be seen at the Office of the Water District, 501 Tribune Building.

The lowest or any tender not necessarily accepted.

R. D. WAUGH,
Chairman of Commissioners,
Greater Winnipeg Water District,
306 501 Tribune Building, Winnipeg.

SALE OF UNUSED ARTICLES AT KINGSTON PENITENTIARY

Sealed tenders, addressed "Superintendent of Penitentiaries, Ottawa, and endorsed tenders for unused articles at Kingston Penitentiary," will be received until Saturday, August 30th, 1919, for the following:—

One Worthington type compound pump, Duplex, 12" x 19" by 10" x 10" stroke (repairs required).

Two Worthington boiler feed pumps, Duplex, 6" x 4" x 6" (require repairs).

One Smithvale boiler feed pump, 4½" x 3" x 4½" (in good condition).

One Worthington boiler feed pump, 6" x 4" x 6", Duplex (some parts missing).

One double acting Bilge pump, 3" x 6".

One galvanized iron 5" exhaust head.

One cast iron bath.

One 36" x 11" McGachin's blower with drive for Jones' underfeed stokers.

One Ideal centre crank engine 6" x 6" x 350 r.p.m. (in good condition).

One 6" x 9" vertical engine (requires repairs).

One 10" x 10" x 325 r.p.m. peerless self-oiling engine, direct connected to a 280 amp., 110 volt, D.C., united electric generator (in good order). Complete set of instruments (except volt meter, mounted on wooden template for generator).

One Daisy No. 7 high base, 1910 pattern, hot water furnace, no headers (good as new).

One Gurney-Oxford No. 8 low base hot water furnace, no headers (good as new).

Two Aetna hot water furnaces.

One old hot water furnace (scrap).

About 500 feet 4" cast iron piping with fittings.

Two 10-branch manifold headers for hot water furnace.

One tank 7' x 7' x 3' 6", ¼" plate, riveted and bolted.

One 42" x 11" x 36' (3" tubes), R.T. boiler, flush front (good for low pressure).

Eighteen feet of 2-ft. iron stack.

One piece boiler plate 6' x 6' x 11/16".

One R.T. boiler, 3' 6" x 10" x 38' (3" tubes) overhanging front (good condition and inspected).

One 30" x 6' x ⅜" plate, pressure tank (sound).

Sundry old radiators and steam traps.

Three 24" x 36" cast iron sinks.

Two marble mantel shelves, 5' x 1' x 1".

One marble mantel shelf 5' 6" x 1' x 1".

One marble mantel shelf 3' 6" x 1' 6" x 1".

Sundry pcs. white marble 1" thick.

One cast iron basin.

One punching press.

One fan.

One fence machine.

5½ pairs axle bearings.

14 axe boxes.

400 spiral wire pickets.

77 bushel baskets.

2 weaving looms.

94 pounds lea tow.

1,222 yards white warp.

1,926 enamel dishes (new).

Most of the above articles are in a fair state of repair and may be viewed at the Kingston Penitentiary, Kingston, Ont. Terms of sale cash. Articles purchased to be removed from the Kingston Penitentiary before September 30th, 1919. Check amounting to ten per cent. of tendered price must accompany all offers.

Papers inserting this notice without authority from the King's Printer will not be paid therefor.

(Signed) W. S. HUGHES, D.S.O.,
Superintendent of Penitentiaries.

Department of Justice,
Ottawa, July 15th, 1919. 305

The Canadian Engineer

A Weekly Paper for Civil Engineers and Contractors

Formulae for One-Story and Two-Story Bents

Elastic Deformation Method Used for Exact Determination of Stresses in Simple Types of Structures—Equations Derived Analytically to Save Time for Designing Engineers Engaged in Steel or Reinforced Concrete Construction

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WHEN designing one-story and two-story bents, without diagonals, subject to horizontal forces, engineers usually base their design upon some assumption as to the location of the points of contraflexure of the columns.

Following such assumption, the bending moments produced in the columns by the horizontal forces are easily calculated. It is evident, however, that the location of the points of contraflexure is dependent upon the relative moments of inertia of the columns and struts, since the stiffness of the struts as compared to the columns determines the amount of deflection at the joints. The results obtained by this method of calculation are, of course, only approximate.

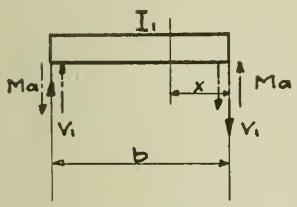

FIG. 1

In this article, an analysis, based upon the elastic theory of structures, is made in order to determine the bending moments and the location of the points of contraflexure in the columns of a two-story bent. From the formulæ thus derived, the ten different cases illustrated by Figs. 6 to 15 are deduced.

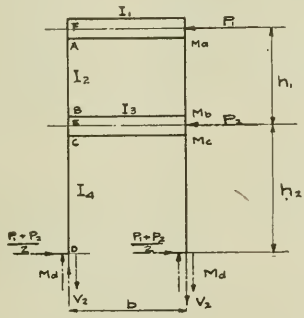

FIG. 2

If the structure be subject to vertical forces as well as horizontal, it is but necessary to make an algebraical addition of the stresses produced by the different forces.

In this article the following assumptions are made:—

(1)—That each column takes one-half the load.

(2)—That the connection of the column to the strut is rigid.

(3)—That the foundations are non-yielding.

All dimensions are expressed in the same units, and the following nomenclature is used:—

P_1 and P_2 Horizontal forces.

h_1 and h_2 and b Distances as shown in figures.

I_1 and I_3 Moment of inertia of upper and lower girder, respectively.

I_2 and I_4 Moment of inertia of upper and lower column, respectively.

M_a Moment at junction of upper column and upper girder.

M_b Moment at junction of upper column and lower girder.

M_c Moment at junction of lower column and lower girder.

M_d Moment at base of column.

x_1 and x_2 Distances to points of contraflexure.

Referring to Fig. 2, the moments about E may be expressed as follows:—

$$P_1h_1 = 2M_b+V_1b.$$

Solving for V_1,

$$V_1 = (P_1h_1-2M_b)/b \quad \ldots\ldots(1)$$

Again referring to Fig. 2, the moments about D may be expressed as follows:—

$$P_1(h_1+h_2)+P_2h_2 = 2M_d+V_2b.$$

Solving for V_2,

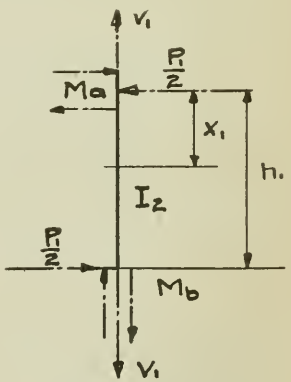

FIG. 3

$$V_2 = [P_1(h_1+h_2)+P_2h_2-2M_d]/b \quad \ldots\ldots(2)$$

Then,

$$V_2-V_1 = [(P_1+P_2)h_2-2M_d+2M_b]/b \quad \ldots\ldots(3)$$

Referring to Fig. 1, the moments about F are

$$V_1b = 2M_a.$$

Solving for M_a and substituting the value for V_1 from Equ. 1,

$$M_a = (P_1h_1/2)-M_b \quad \ldots\ldots(4)$$

Referring again to the moments about E (see Fig. 2),

$$(P_1+P_2)h_2-2M_d = 2M_c.$$

From this,

$$M_c = \tfrac{1}{2}(P_1+P_2)h_2-M_d \quad \ldots\ldots(5)$$

The equation of the elastic curve (see Fig. 1) is

$$EI_1(d^2y/dx^2) = V_1x-M_a.$$

By integrating,

$$EI_1(dy/dx) = \tfrac{1}{2}V_1x^2-M_ax+C_1.$$

When $dy/dx = (dy/dx)_A$, and $x = 0$,

$$C_1 = EI_1(dy/dx)_A.$$

By substituting in above,

$$EI_1(dy/dx) = \tfrac{1}{2}V_1x^2-M_ax+EI_1(dy/dx)_A.$$

Integrating again,

$$EI_1y = \tfrac{1}{6}V_1x^3-\tfrac{1}{2}M_ax^2+EI_1(dy/dx)_Ax+C_2.$$

$C_3 = 0$. When $y = 0$ and $x = b$, substituting for V_1 from Equ. 1, and for M_b from Equ. 4,

$$(dy/dx)_A = M_a b/6EI_1 \quad \ldots\ldots\ldots\ldots\ldots\ldots (6)$$

For convenience, x and y axis will be turned through 90 degs. when considering vertical posts.

Referring to Fig. 3,

$$EI_2(d^2y/dx^2) = M_a - \tfrac{1}{2}P_1x.$$

By integrating,

$$EI_2(dy/dx) = M_a x - \tfrac{1}{4}P_1x^2 + C_1.$$

When $dy/dx = (dy/dx)_A = M_a b/6EI_1$, and $x = 0$,

$$C_1 = M_a bI_2/6I_1.$$

Substituting this value for C_1 in the above equation,

$$EI_2(dy/dx) = M_a x - \tfrac{1}{4}P_1x^2 + (M_a bI_2/6I_1).$$

When $dy/dx = (dy/dx)_B$, and $x = h_2$,

$$(dy/dx)_B = (dy/dx)_C = (M_a h_1/EI_2) + (M_a b/6EI_1) - (P_1h_2^2/4EI_2) \quad \ldots\ldots\ldots (7)$$

Referring to Fig. 4,

$$EI_2(d^2y/dx^2) = (V_2 - V_1)x - M_b - M_c.$$

Integrating,

$$EI_2(dy/dx) = (V_2 - V_1)\tfrac{1}{2}x^2 - (M_b + M_c)x + C_1$$

When $dy/dx = (dy/dx)_B$, and $x = 0$,

$$C_1 = EI_2(dy/dx)_B.$$

Substituting these values in the above equation,

$$EI_2(dy/dx) = (V_2 - V_1)\tfrac{1}{2}x^2 - (M_b + M_c)x + (M_a h_1 I_2/I_1) + (M_a bI_2/6I_1) - (P_2h_1^2I_2/4I_1).$$

Integrating again,

$$EI_2y = (V_2 - V_1)\tfrac{1}{6}x^3 - (M_b + M_c)\tfrac{1}{2}x^2 + [(M_a h_1 I_2/I_1) + (M_a bI_2/6I_1) - (P_2h_1^2I_2/4I_1)]x + C_2.$$

$C_2 = 0$. When $y = 0$ and $x = b$,

$$(M_b + M_c)\tfrac{1}{2}b - M_a[(h_1I_2/I_1) + (bI_2/6I_1)] = (V_2 - V_1)\tfrac{1}{6}b^2 - (P_2h_1^2I_2/4I_1).$$

Substituting for $(V_2 - V_1)$ from Equ. 3, and for M_b and M_c from Equ. 4 and Equ. 5, respectively, and solving for M_d,

$$M_d = \tfrac{1}{2}(P_2h_1 + P_2h_2 + P_2h_2) - M_a\{1 + (6I_2/b)[(h_1/I_1) + (b\ 6I_1)]\} + 3P_2h_1^2I_2/2bI_2 \quad \ldots\ldots\ldots\ldots (8)$$

Referring to Fig. 5, $EI_4(d^2y/dx^2) = M_d - \tfrac{1}{2}(P_1 + P_2)x$. Integrating,

$$EI_4(dy/dx) = M_d x - \tfrac{1}{4}(P_1 + P_2)x^2 + C_1.$$

$C_1 = 0$. When $dy/dx = (dy/dx)_C$ and $x = h_2$,

$$(M_a h_1 I_4/I_2) + (M_a bI_4/6I_1) - (P_2h_1^2I_4/4I_2) = M_d h_2 - \tfrac{1}{4}(P_1 + P_2)h_2^2.$$

Solving for M_d,

$$M_d = (M_a I_4/h_2)[(h_1/I_2) + b/6I_1)] + \tfrac{1}{4}(P_1 + P_2)h_2 - (P_2h_1^2I_4/4I_2h_2) \quad \ldots\ldots\ldots\ldots (9)$$

Solving for M_a from Equ. 8 and Equ. 9,

$$M_a = \{\tfrac{1}{4}(2P_2h_1 + P_2h_2 + P_2h_2) + (3P_2h_1^2/2I_2)[(I_4\ 6h_2) + (I_2/b)]\} \div \{1 + [(h_1/I_2) + (b/6I_1)][(I_4/h_2) + (6I_2/b)]\} \quad \ldots\ldots (10)$$

From Equ. 5 and Equ. 9,

$$M_c = \tfrac{1}{4}(P_1 + P_2)h_2 + (P_2h_1^2I_4/4I_2h_2) - (M_a I_4/h_2)[(h_1/I_2) + (b/6I_1)] \quad \ldots\ldots\ldots\ldots (11)$$

Case 1 (Fig. 6)

Fig. 6 corresponds to Fig. 1, and the four equations for the moments M_a, M_b, M_c and M_d are, respectively, equations 10, 4, 11 and 5 given above.

Figs. 7 to 15, both inclusive, are special cases, and the values for their moments were obtained by substituting the proper values in the above equations, as shown. Values for points of contraflexure were derived by equating the second derivative of the equation for the elastic curve equal to zero. For Case 1 (Fig. 6),

$$x_1 = 2M_a/P_1 \quad \ldots\ldots\ldots\ldots\ldots\ldots (12)$$

$$x_2 = 2M_d/(P_1 + P_2) \quad \ldots\ldots\ldots\ldots\ldots\ldots (13)$$

Case 2 (Fig. 7)

Fig. 7 represents Case 2,

$M_d = 0$. Substitute for M_d in Equ. 8.

$$M_a = [\tfrac{1}{2}(P_2h_1 + P_2h_2 + P_2h_2) + (3P_2h_1^2I_2/2bI_2)] \div \{1 + (6I_2/b)[(h_1/I_2) + (b/6I_1)]\} \quad \ldots\ldots\ldots (14)$$

For M_b, see Equ. 4.

Substituting $M_d = 0$ in Equ. 5.

$$M_c = \tfrac{1}{2}(P_1 + P_2)h_2 \quad \ldots\ldots\ldots\ldots\ldots\ldots (15)$$

For x_1, see Equ. 12.

Case 3 (Fig. 8)

Fig. 8 represents Case 3.

$P_2 = 0$, $I_2 = 0$, $I_4 = I_2$, and $h_1 + h_2 = h$. Substituting in Equ. 10,

$$M_a = (3P_2h^2I_1)/2(bI_2 + 6hI_1) \quad \ldots\ldots\ldots\ldots\ldots\ldots (16)$$

For M_b, see Equ. 4.

$$x_2 = 2M_b/P_1 \quad \ldots\ldots\ldots\ldots\ldots\ldots (17)$$

Case 4 (Fig. 9)

Fig. 9 represents Case 4.

$M_b = 0$. Substituting in Equ. 4,

$$M_a = P_2h/2 \quad \ldots\ldots\ldots\ldots\ldots\ldots (18)$$

Case 5 (Fig. 10)

Fig. 10 represents Case 5.

$P_2 = 0$. Substituting in Equ. 10,

$$M_a = \{\tfrac{1}{4}P_1(2h_1 + h_2) + (3P_2h_1^2/2I_2)[(I_4/6h_2) + (I_2/b)]\} \div \{1 + [(h_1/I_2) + (b/6I_2)][(I_4/h_2) + (6I_2/b)]\} \quad \ldots\ldots\ldots (19)$$

Substituting $P_2 = 0$ in Equ. 4,

$$M_b = (P_1h_2/2) - M_a \quad \ldots\ldots\ldots\ldots\ldots\ldots (20)$$

Substituting $P_2 = 0$ in Equ. 11,

$$M_c = \tfrac{1}{4}P_1h_2 + (P_1h_2^2I_4/4I_2h_2) - (M_a I_4/h_2) \times [(h_1/I_2) + (b/6I_1)] \quad \ldots\ldots\ldots\ldots\ldots (21)$$

Substituting $P_2 = 0$ in Equ. 5,

$$M_d = (P_1h_2/2) - M_c \quad \ldots\ldots\ldots\ldots\ldots\ldots (22)$$

For x_2, see Equ. 12.

$$x_2 = 2M_d/P_1 \quad \ldots\ldots\ldots\ldots\ldots\ldots (23)$$

Case 6 (Fig. 11)

Fig. 11 represents Case 6.

$P_2 = 0$ and $M_d = 0$. Substituting in Equ. 14,

$$M_a = [\tfrac{1}{2}P_1(h_1 + h_2) + (3P_1h_1^2I_2/2bI_2)] \div \{1 + (6I_2/b)[(h_1/I_2) + (b/6I_1)]\} \quad \ldots\ldots\ldots (24)$$

For M_b, see Equ. 20.

Substituting $P_2 = 0$ in Equ. 15,

$$M_c = P_1h_2/2 \quad \ldots\ldots\ldots\ldots\ldots\ldots (25)$$

For x_1, see Equ. 12.

Case 7 (Fig. 12)

Fig. 12 represents Case 7.

$P_1 = 0$. Substituting in Equ. 10,

$$M_a = (\tfrac{1}{4}P_2h_2) \div \{1 + [(h_1/I_2) + (b/6I_1)][(I_4/h_2) + (6I_2/b)]\} \quad \ldots\ldots (26)$$

Substituting $P_1 = 0$ in Equ. 4,

$$M_b = -M_a \quad \ldots\ldots\ldots\ldots\ldots\ldots (27)$$

Substituting $P_1 = 0$ in Equ. 11,

$$M_c = \tfrac{1}{4}P_2h_2 - (M_a I_4/h_2)[(h_1/I_2) + (b/6I_1)] \quad \ldots\ldots\ldots (28)$$

Substituting $P_1 = 0$ in Equ. 5,

$$M_d = \tfrac{1}{2}P_2h_2 - M_c \quad \ldots\ldots\ldots\ldots\ldots\ldots (29)$$

$$x_2 = 2M_d/P_2 \quad \ldots\ldots\ldots\ldots\ldots\ldots (30)$$

Case 8 (Fig. 13)

Fig. 13 represents Case 8.

$P_2 = 0$ and $M_d = 0$. Substituting in Equ. 14,

$$M_a = (\tfrac{1}{2}P_2h_2) \div \{1 + (6I_2/b)[(h_1/I_2) + (b/6I_1)]\} \quad \ldots\ldots (31)$$

For M_b, see Equ. 27.

From Equ. 15,

$$M_c = P_2h_2/2 \quad \ldots\ldots\ldots\ldots\ldots\ldots (32)$$

Case 9 (Fig. 14)

Fig 14 represents Case 9.

P_2 acts in opposite direction to P_1. Substituting $-P_2$ for $+P_2$ in Equ. 10,

$$M_a = \{\tfrac{1}{4}(2P_1h_1 + P_1h_2 - P_2h_2) + (3P_1h_1^2/2I_2)[(I_4/6h_2) + (I_2/b)]\} \div \{1 + [(h_1/I_2) + (b/6I_1)][(I_4/h_2) + (6I_2/b)]\} \quad \ldots\ldots\ldots (33)$$

For M_b, see Equ. 4.

From Equ. 11,

$$M_c = \tfrac{1}{4}(P_1 - P_2)h_2 + (P_1h_1^2I_4/4I_2h_2) - (M_a I_4/h_2)[(h_1/I_2) + (b/6I_1)] \quad \ldots\ldots\ldots (34)$$

From Equ. 5,

$$M_d = \tfrac{1}{2}(P_1 - P_2)h_2 - M_c \quad \ldots\ldots\ldots\ldots\ldots\ldots (35)$$

For x_1, see Equ. 12.

$$x_2 = 2M_d/(P_1 - P_2) \quad \ldots\ldots\ldots\ldots\ldots\ldots (36)$$

Case 10 (Fig. 15)

Fig. 15 represents Case 10.

P_2 acts in opposite direction to P_1, and $M_d = 0$. Substituting $-P_2$ for $+P_2$ in Equ. 14,

$$M_a = [\tfrac{1}{2}(P_1h_1 + P_1h_2 - P_2h_2) + (3P_1h_1^2I_2/2bI_2)] \div \{1 + (6I_2/b)[(h_1/I_2) + (b/6I_1)]\} \quad \ldots\ldots\ldots (37)$$

For M_b, see Equ. 4.

From Equ. 15,

$$M_c = \tfrac{1}{2}(P_1 - P_2)h_2 \quad \ldots\ldots\ldots\ldots\ldots\ldots (38)$$

And, as previously, $x_1 = 2M_a/P_1$.

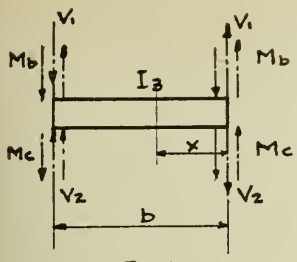

FIG. 4

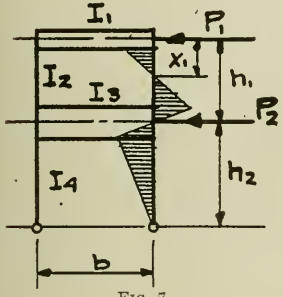

FIG. 7

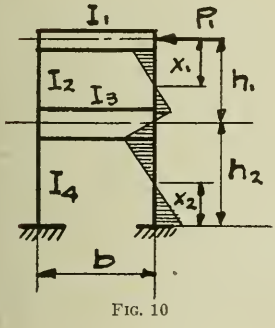

FIG. 10

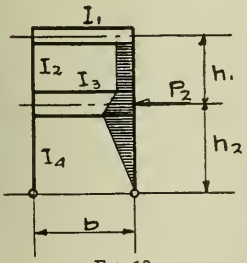

FIG. 13

DIAGRAMS ILLUSTRATING ARTICLE BY E. MAERKER, "FORMULAE FOR ONE-STORY AND TWO-STORY BENTS"

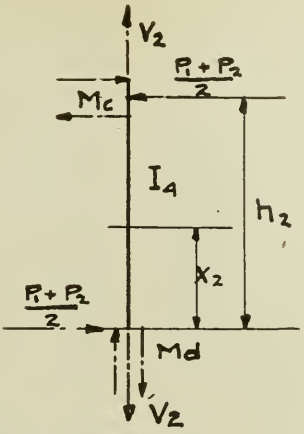

FIG. 5

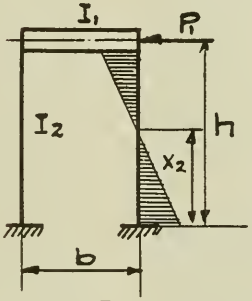

FIG. 8

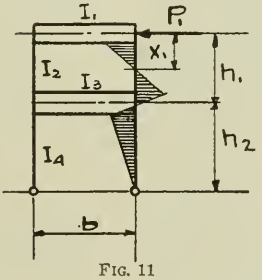

FIG. 11

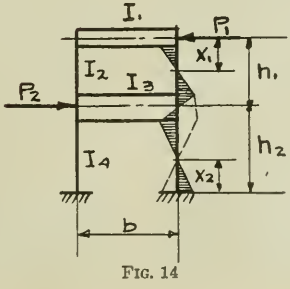

FIG. 14

FIGS. 6 TO 15 ILLUSTRATE TEN DIFFERENT CASES—ANALYSIS BASED UPON ELASTIC THEORY OF STRUCTURES

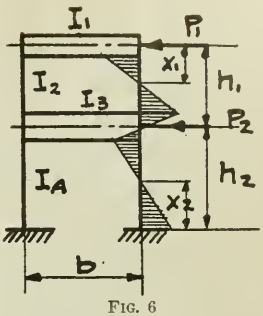

FIG. 6

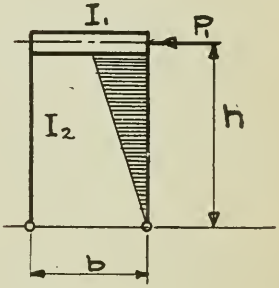

FIG. 9

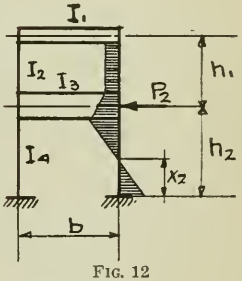

FIG. 12

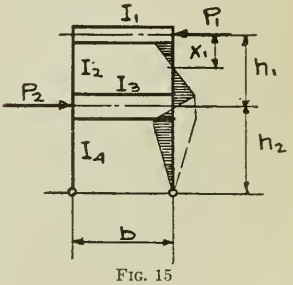

FIG. 15

LIGNITE BOARD ENCOUNTERED DIFFICULTIES

Published Information Led the Board to Believe that the Carbonization of Lignites Had Advanced Further Than Investigation Proved to be the Case

THAT the Lignite Utilization Board of Canada met difficulties in designing a plant for the economical carbonization of Saskatchewan's lignite in commercial quantities, is shown by the following statement recently issued by the Board:—

At the commencement of the Board's activities on October 1st, 1918, it was decided that every briquetting and coal treating plant in the United States and Canada, where information pertinent to lignite carbonization might be available, ought to be visited by the board's engineers, in order that the last word on carbonizing and briquetting might be obtained. At that time it was hoped that, as a result of this investigation, the board's engineers would be able, on their return, to recommend that such-and-such carbonizers be adopted, such-and-such mixers, and such-and-such briquetting presses. It would then have been possible to proceed immediately with the erection of the plant and purchase of machinery. It should be noted that a great deal of published information had led the board to believe that the carbonization of lignite had advanced further than actual personal investigation proved to be the case. Their expectations, therefore, in regard to carbonizing of lignite were not realized, and it became necessary for the board to develop a special type of carbonizer that might be suitable for the low-grade Saskatchewan deposits.

The results of the investigation of crushers, dryers, mixers and presses were, however, much more encouraging. It became evident that various commercial machines could be obtained in the open market that would be suitable for the board's needs with but slight alterations.

Present Program

The present program may be briefly summed up as follows: The board is developing a special type of carbonizer, and within a couple of weeks the preliminary trials of this apparatus will be made. In the event of success, the board's plans will permit it to start the erection of a plant during this coming autumn. In the event of this carbonizer not being successful, further designs will be made, but the board is determined that not one dollar will be spent on large retort equipment until it is absolutely certain of the ground now being explored.

In addition to its own researches, the board has arranged with a number of investigators in Canada, the United States and Great Britain, to undertake certain experimental programs. In this way, the board is sure of having at its command the best scientific information along these lines that can possibly be secured.

Site of Proposed Plant

The board has collected as much data as possible on the physical characteristic of the whole Souris field. This data includes information on depth, width, quality and ash content of the seams in each mine, the stratification of the whole area, water supply, topographical characteristics, approximate values of land, quantity of slack available in mines, population of the various towns, and railway facilities. In addition, the board has come to an arrangement with the Department of the Interior whereby no new mining lease within a radius of 20 miles of Estevan will be granted without the board's certificate that such lease will not conflict with the future operations of the board. In this way the interests of the public are safeguarded. No immediate decision, however, will be announced as to the exact location of the proposed plant.

Difficulties of Board's Program

The main divisions of the process of producing a carbonized and briquetted domestic fuel from raw lignite are as follows: (a) Crushing, (b) drying, (c) pulverizing, (d) carbonizing, (e) mixing, (f) briquetting, (g) water-proofing, and (h) cooling. These steps will be discussed briefly, in order that it may be clearly seen what the board is attempting to do. It must be noted that the following remarks are applicable specifically to the Saskatchewan lignites.

(a) and (c). Enough information regarding crushing and pulverizing is at hand to know that these processes can probably be carried out by means of some type of standard apparatus at present on the market. In any event only slight changes will be necessary in order to make existing machinery practicable.

(b). Certain technical difficulties exist with the drying. Standard machinery that can be purchased in the open market, however, will probably be suitable.

(d). As mentioned above, the question of the commercial carbonization of lignite is one that presents, at the moment, the most difficulty to the board. It is also at this point that the board's objectives differ most widely from those of so many firms in the United States that are retorting coal on a large scale. The latter have in mind the production of the maximum quantity of by-products, while the defined objective of the Lignite Board is the production of the maximum number of heat units in the residue, in order that it may be available as a domestic fuel. These differences are the more marked when it is remembered that the successful coal-treating firms of the United States are dealing with a much higher grade of fuel than the Lignite Utilization Board. There is no question that the carbonization of the lignite *can* be accomplished. The only point is, how cheaply can it be done on a commercial scale with commercial apparatus and with commercial quantities. In order to solve this specific problem, the board, through the courtesy of the Department of Mines, Mines Branch, has been erecting a small experimental plant at Ottawa, which is, however, to be suplied with units that, though small, may still be regarded as commercial. In this plant the new carbonizer is one toward which the board is looking with great hopes.

Mention has already been made of the fact that the board has not only its own investigations under way, but has arranged with a number of well-known scientists to undertake special research work on carbonization.

(f). The question of briquetting is one that is practically solved, and the board's present objective is to discover the minimum quantities of those binders which are available in commercial quantities in the west. It is interesting to note that the amount of binder necessary for carbonizing lignite is very much in excess of the quantity of the same binder necessary for briquetting anthracite. Enough information with regard to briquetting and binding, however, is now in the board's possession to enable it to state that, for briquetting presses, it will probably be able to utilize existing commercial machinery with but slight alterations.

(g). In order that the briquettes may be smokeless, it will be necessary to subject them to a heat treatment, and it only remains to determine whether this heat treatment can be made sufficiently cheap to warrant its adoption.

(h). Cooling. This is purely a commercial detail.

Probable Future Construction

At present the board wishes to guard against any absolute promises, because future construction is entirely dependent upon the results of the experimental investigations now going on at Ottawa and elsewhere. The board has plans and layouts sufficiently advanced to proceed at the earliest moment with the letting of contracts, purchase of land, machinery, etc., provided the experiments are successful. The board hopes that erection of the plant itself may be started by October or November, 1919. If the experiments are not successful, the whole matter must wait until success is achieved, because the board will not under any circumstances spend public funds for one dollar's worth of capital equipment that might afterwards prove unsuitable.

Jones & Attwood, Ltd., of Stourbridge, Eng., who are the owners of the patents on the activated sludge method of sewage disposal, and who have been the pioneers in its development in England, are transferring the activated sludge department of their business to a newly-formed firm, Activated Sludge, Limited, of Stourbridge.

EFFECT OF RODDING CONCRETE

By F. E. Giesecke
Professor of Architectural Engineering, University of Texas, Austin, Tex.

In a series of tests made at the University of Texas to determine the physical properties of dense concrete as determined by the relative quantity of cement, described in Bulletin No. 1815, published March 10th, 1918, only sufficient mixing water was used to secure a concrete of workable consistency. For comparison, however, a few specimens were prepared with an excess of water, which produced a very considerable reduction in strength, as was shown in Fig. 8 of the above-mentioned bulletin.

In practical operation it is almost absolutely necessary to use enough excess water to make the concrete sufficiently fluid to be handled in wheel-barrows, carriages or tubes, and so that it will flow readily into the forms and between and around the reinforcing steel.

With these facts before us—that an excess of water must be used to place the concrete correctly and economically, and that this excess water materially reduces the strength of the concrete—the question naturally arises, what, if anything, can be done to repair the injury that is done by the excess water?

To answer this question, G. A. Parkinson, assistant testing engineer, University of Texas, made a number of

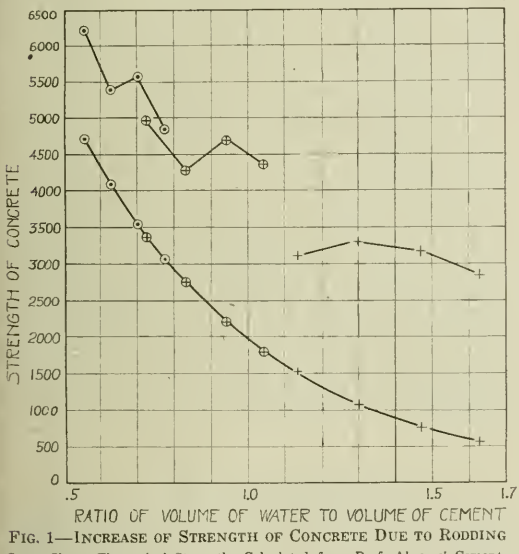

Fig. 1—Increase of Strength of Concrete Due to Rodding

Curve Shows Theoretical Strengths Calculated from Prof. Abrams' Cement-Water Formula (Assuming the Constants as 7 and 14,000), While Broken Lines Show Tested Strengths of Same Concrete after Roddings.

experiments in the fall and winter of 1917, to determine the effect of removing the excess water from the concrete after the latter had been deposited in the forms.

In these experiments the excess water was removed by forcing a pointed iron rod into the concrete while the latter was still soft; the effect of running such a rod into the concrete is to permit the excess water and entrapped air to escape upward, and to compact the aggregate; as a result the density of the concrete is increased about 4%.

This method of treating concrete has been named "rodding"; it is quite similar to "spading," but differs materially from "tamping." The results of Mr. Parkinson's early work were so very satisfactory that an extended series of tests was begun in June, 1918, and this was followed by other series of tests as new phases of this method of treating concrete developed. Some of these tests are still incomplete; but considerable important data have been secured and the following will be of interest.

Fig. 2 shows graphically the ultimate unit compressive strengths of fifty-four 6 by 12-in. cylinders. The concrete had the following composition:—

Material.	Percentage.
Cement	14.40
Passing 35-mesh sieve	4.35
Passing 12-mesh sieve and retained on 35-mesh sieve	9.00
Passing ¼-in. sieve and retained on 12-mesh sieve	13.00
Passing ¾-in. sieve and retained on ¼-in. sieve	29.50
Passing 1¼-in. sieve and retained on ¾-in. sieve	29.75
	100.00
Water	10.00

The 54 cylinders were divided into three groups of 18 cylinders each. In each group one cylinder was not rodded; the remaining 17 were rodded from one to seventeen times. In one group a 10-min. interval was allowed between roddings; in another a 20-min. interval; and in the third group, a 30-min. interval. The first rodding was applied soon after the moulds were filled; i.e., without waiting for the full interval of time assigned the particular series to pass. By one rodding is to be understood the pushing of a pointed

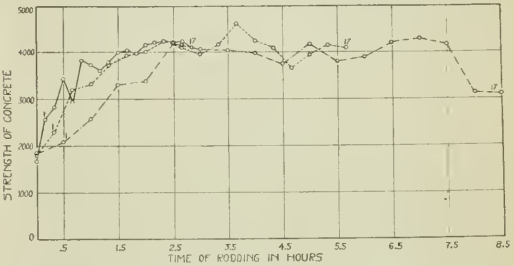

Fig. 2—Variation in the Increase of Strength of Concrete, Due to Rodding, with the Number of Roddings

iron rod into the concrete to the full depth of the concrete once for every surface area of about 3 sq. ins.; i.e., about ten times for a 6-in. cylinder.

It is interesting to note:—

(a)—That the maximum strength is about 130% more than that of the unrodded specimens.

(b)—That all three series acquired their maximum strength in about 2 or 2½ hrs.

(c)—That for the 30-min. interval it required 5 roddings; for the 20-min. interval, 7 roddings; and for the 10-min. interval, 14 roddings, to secure the maximum strength.

It is probable that the length of time and the number of roddings necessary to secure the maximum strength vary with the temperature and with the percentages of cement and water.

Fig. 1 shows graphically by the broken lines the average ultimate unit compressive strengths of thirty-six 6 by 12-in. cylinders arranged in twelve groups of three cylinders each.

The intermediate group, represented by crosses within circles, was made of concrete having the same composition as that represented in Fig. 2; but the mixing water was 7% for three cylinders, 8% for three, 9% for three, and 10% for three. This concrete contains cement at the rate of about six sacks of cement per cubic yard of concrete.

The two other groups are of similar composition, but the cement content changed to about four and eight sacks respectively per cubic yard. The percentages of water for the lean mixes were the same as for the intermediate, but for the rich mixes they were increased, respectively, to 7½, 8½, 9½ and 10½%.

To compare these results with the strength of plain concrete, the work of the Lewis Institute, of Chicago, as reported by Prof. Abrams, was selected as being probably the latest and most reliable, and probably also the most appropriate, since it gave special attention to the effect of excess water on the strength of the resulting concrete.

According to the Lewis Institute tests the strength of concrete is a function of the ratio of the volumes of water to that of the cement used in the production of the concrete, and is 14,000 ÷ 7^R lbs. per sq. in. for cement 28 days old, R being the ratio referred to, and the weight of one cubic foot of cement being assumed as 94 lbs. The curved line shows the strength of the twelve groups of specimens as calculated by this formula.

An inspection of Fig. 1 shows:—

(1)—That the effect of rodding concrete is more beneficial with lean than with rich mixes, and that it is more beneficial with wet than with dry mixes.

(2)—That the average strength of 8-sack concrete can be increased about 45% by rodding; that of 6-sack, about 60%; and that of 4-sack, about 220%.

To appreciate how well the values shown in Fig. 2 (determined by test July 11th, 1919) check with those shown by the broken line in Fig. 1 (determined by test March 19th, 1919) and with those shown by the curved line in Fig. 1 (calculated from the Lewis Institute formula), notice that the average strength of the unrodded specimens shown in Fig. 2 is about 1,800 lbs., and that this is almost exactly the same as that shown by the curved line in Fig. 1 for the 6-sack concrete with 10% of water; also that the strength shown by Fig. 2 increases gradually with the roddings to about 4,250 lbs., which is a trifle less than that shown by the broken line in Fig. 1 for the 6-sack concrete with 10% of water.

WORLD IS ON HIGHER PRICE LEVEL*

By T. S. Holden

Investigator Economics Section, Division of Public Works and Constructive Developments, U.S. Department of Labor

IN our capacity as buyers of commodities we have proceeded on the assumption that it was desirable for prices to fall. Falling prices rarely stimulate business. They usually stimulate waiting for further declines. A period of falling prices is usually a period of business depression. The past six months has been remarkable for the small number of business failures. It is entirely possible that a sharp decline in prices might have been accompanied by a greater number of business failures than there has been, attended with a much greater menace of unemployment. A financial panic might have been within the bounds of possibility.

Many of those who have been deferring building projects and the resumption of production of commodities have stated that they were waiting until prices and wages should have returned to "normal." The word "normal" has been used extensively in this connection and most of those who have used it have not appreciated the true meaning of the word. Not only in connection with prices and wages has this term been used incorrectly, but courts and public utility commissions have used the term loosely when speaking of valuations of properties. It is worth while to determine just what this word means in connection with prices, wages and property values, not in the interest of academic precision but simply to aid clear thinking on this subject.

A paper entitled "Appraisals and Rate Making" was read March 20th at the annual meeting of the Illinois Gas Association by Cecil F. Elmes, an eminent engineer. In this paper Mr. Elmes presented with the utmost clarity and force, certain aspects of the price situation as affecting valuations of public utility properties and the principles of rate making. In the course of his discussion Mr. Elmes dwelt at some length on the misconception of the term "normal." He presented curves showing the fluctuations of prices in England on five basic articles, wheat, iron, lead, cattle and sheep, covering a period of six centuries. He also presented curves showing fluctuations of artisans' wages, both in terms of money and in terms of the quantity of wheat the wages would buy, covering the same extended period. He pointed out that in the case of each one of these curves the fluctuations are so erratic that it is impossible to draw a horizontal straight line, an oblique straight line, or a mathematical curve which could in any sense serve as a median about which the prices or wages fluctuate. Consequently, it is not possible to define mathematically in terms of past experience the "normal" price of a given commodity, or "normal" wages. Neither is it possible to thus define a "normal" rate of increase in prices or wages.

Not everyone has the opportunity to consult the records of the British museum, as Mr. Elmes has had, for the purpose of studying this subject. There is, however, another authority which is readily accessible to all, Webster's Dictionary. Webster defines the term in connection with economics as follows:—

"Pertaining or conforming to a more or less permanent standard, from which, if the individual phenomena deviate on either side, such deviations are to be regarded as self-corrective. Thus, in economics, the normal price is a price which corresponds to the cost of production."

Relation of Price and Cost

The standard to which a price must conform is, therefore, not necessarily a price that we are accustomed to, or that we were accustomed to five years ago. Mr. Elmes has shown that past experience has established no mathematical standard to which a price may be expected to conform. Webster says that the standard is the cost of production. In 1919 the standard is the cost of production in 1919, and not the 1914 cost of production. There is no justification for assuming that $12 is an unfair price for a pair of shoes to-day, simply because the same pair of shoes might have been bought in 1914 for $6. The only criterion for the present price of shoes is the present cost of production of the shoes plus a reasonable margin of profit to those concerned in the making and the selling of the shoes.

Similarly "normal" wages in 1919 must not necessarily conform to the wage scale of 1914. "Normal" wages in 1919 must cover the cost of living in 1919 with a reasonable margin.

Similarly, the fact that the customary street car fare in the past has been 5 cents is not necessarily an indication that a 5-cent fare is the "normal" fare in 1919. As in the case of prices and wages, the standard of the rate to be paid for the services rendered by any public utility corporation is not fundamentally the rate the public has been accustomed to pay, but the cost of production of the commodity that is being sold, whether it be gas, electric power or transportation.

It is also true that the normal valuation in 1919 of any piece of property, whether it be improved real estate or a public utility is, fundamentally, the total cost of production of that property under the conditions of material prices and wages in 1919.

Purchasing Power of the Dollar

Another element of confusion has arisen in the minds of some in the attempt to draw a distinction between the purchasing power of the dollar and the value of the dollar. It has been stated that the purchasing power of the dollar measured in commodity prices has been cut in half, but the value of the dollar, which should be measured in terms of the wealth of the country, consisting of real and personal property, has not risen. On the basis of this distinction it was argued that prices must fall in order that the purchasing power of the dollar might become commensurate with the value of the dollar. It appears to be an economic fallacy to draw such a distinction. John Stuart Mill defines values as follows:—

"The value of a thing is its general power of purchase, the command which its possession gives over purchasable commodities in general."

In other words, the value of the dollar is the purchasing power of the dollar. Furthermore, contrary to the argument outlined above, prices have remained high and rents and property valuations have been increasing since the time the statement referred to above was made.

The owner of a house and lot may state to the tax assessor that the value of his property is $10,000. In making a

*Abstract of prepared testimony submitted to the Public Utilities Committee of the Chamber of Commerce of the United States.

statement of his assets and liabilties for the purpose of securing credit he may place the value of his property at $15,000. In his own mind he realizes that these valuations are more or less fictitious, though perhaps justified by custom. However, if he knows that the price which he can get for the property is $12,000, he knows that the actual value of the property is $12,000.

In connection with valuations of public utilities and the fixing of rates, although the basic principle which applies to the price of commodities and wages of labor and valuation of real estate constitutes the standard of normality, it is fully realized that, in practice, restrictions, legal and otherwise, operate to modify the application of this principle. However, it is evident to all that so long as these properties are owned and operated by private interests the return must ultimately be in proportion to the cost of production of that which is sold to the public. When operated by the public through government officials, if the rates paid for the service are not sufficient to cover the costs, the deficit has to be paid out of public funds.

It has been pointed out above that the curve for the fluctuation of prices of any particular commodity covering a long period of years, is so erratic that it is impossible to define from it either a "normal" price of the commodity or a "normal" rate of increase in price. However, if the curve representing the average of prices of a great number of basic commodities be drawn, the fluctuations are much less marked than those of any particular commodity.

Prices and productions costs, which constitute the norm of prices, are measured in terms of money. Wages and the cost of living, which is the norm of wages, are measured with the same yardstick, money.

A chart, covering a period of 46 years in the United States, shows that the curve of the price index for basic commodities keeps very close to parallelism with the curve representing the stock of legal tender in the country.

Early in March Professor Fisher's paper entitled "The New Price Revolution," was published by the Department of Labor. Owing to the fact that this was probably the first announcement to the public that prices would not fall, the statement contained in the paper commanded universal attention. This paper pointed out as the cause of the new price level the increase in the amount of money and credit instruments in the civilized world.

Professor Fisher's statement was followed a month later by a bulletin of the Division of Public Works and Construction, "Development of the Department of Labor," which briefly summarized all those facts concerning the records of foreign prices during the war period, the experience of the Civil War, and the war history of prices of basic commodities in this country, which had a bearing on the present situation. These facts were strictly in accord with Professor Fisher's announcement.

Present Price Level Accepted

During the past few months there has been evident a growing tendency on the part of the public to accept present prices and to wait further only for some assurance that prices would not fall.

The investigating committee appointed by the Illinois State Legislature in its report published May 6th, stated definitely that all the facts it had learned concerning wages and production costs and prices were in accord with the theory that a new price level had been established. As evidence of its complete acceptance of this fact, the legislature immediately authorized the letting of contracts for 650 miles of roads.

The growing volume of building operations throughout the country indicates that the public has largely given over its policy of waiting. The Department of Labor is daily in receipt of statements from leaders in business and finance attesting the correctness of the statements it has published concerning prices.

The Federal Reserve Bulletin for May states:—

"The underlying and most general factor tending to sustain the present high level of values is the credit and banking situation inflated as it is throughout the world. So long as the condition of inflation referred to continues to exist as at present, it must be expected that reductions of price will occur slowly as a result of changes in the demand for and supply of commodities. This will in some cases bring about reductions in the levels of values, but in others will produce corresponding and offsetting variations in the opposite direction. Prices will thus be subject to temporary oscillations, but in order to bring about any broad and far-reaching readjustment affecting the relationship of all commodities to the unit of purchasing power, inflated credit conditions must be eliminated, and the business community must be placed upon practically the footing in relation to credit and money which it is normally to occupy."

One of the factors that has tended to delay building operations has been the tendency on the part of bankers to refuse advances of money on the basis of valuations computed in terms of present prices of materials. It is hoped that the statement of the Federal Reserve Board will influence the bankers to pursue a more liberal policy.

Maximum Level Not Yet Reached

According to figures of the Bureau of Labor Statistics, the maximum level of wholesale prices of basic commodities was reached in September, 1918, the index figure being 207. This figure is based on the average for the year 1913 as 100. The index figure for the month of February was 197, for the month of March it was 200, for the month of April it was 203. Weekly quotations continue to show more commodities advancing than declining. Thus it is seen that the price level is again within hailing distance of the maximum. The question to-day is not whether prices will fall or how much they will fall; it is rather, how much higher will they go? The principal commodities that have advanced recently are foodstuffs. Although there is a surplus in this country, there is a world to be fed; and the world supply is short. Mr. Herbert Hoover has been quoted as stating that wheat would probably go to $3.50 a bushel if all restrictions were removed. The cost of living is still increasing and the dollar is still on the decline. The problem is to arrest this decline in the purchasing power of the dollar.

People want to know to-day what future prices are likely to be. It is impossible to prophesy, but it is possible to view facts that will have a bearing on future prices. From these facts it may be possible to indicate future price tendencies.

It took 13 years after the Civil War for wholesale prices to get back to the pre-war level. The circumstances of that period were much more favorable for price reductions than they appear to be at the present time. As compared with the war just ended the Civil War was a purely local affair.

The reason why the present situation has been so difficult to understand is the fact that it is a world-wide phenomenon. The scope of the economic changes has been as wide as the war itself. In January of this year the Bureau of Labor Statistics' index figure for wholesale prices of all commodities showed an increase of 102 per cent. over the year 1913. At the same time the price level in England was 117 per cent. higher than in 1913; in France it was 249 per cent. higher. It is a significant fact that France, which showed such a marked rise in the price level, resorted to inflation to a much greater extent than did either England or the United States. In England and in America it has been considered wise to pay a large proportion of the expenses of the war through the levying of heavy taxes, thus minimizing the necessity for extension of the public debt and the inflation of currency. In those countries where it was considered expedient to avoid high taxation and to resort to inflation, the people are now paying the piper through the high prices they are obliged to give for the necessities of life.

Whether you believe with the majority of economists that the price level is the result of the amount of money, or whether you agree with the minority that the quantity of money accommodates itself to the price level, the present condition of world-wide high prices accompanied by a world-wide increase of money and credits, must be considered. Either prices in the future will be less because of a contraction in the amount of legal tender, or lower prices in the future must be accompanied by a decrease in the amount

of legal tender. Hence the problem of future prices depends upon the solution of the financial problems and a solution of that can not be wholly controlled by any one country.

Lord D'Abernon, an eminent British financier, has been quoted as follows:—

"If there were to be any attempt to-day to bring about a rapid return to the gold currency basis of 1914 it would almost double the weight of the world's indebtedness and would certainly lead to the bankruptcy of many nations. The governments which have borrowed cheap money would, in the case of contraction, have to repay with dear money. Individuals who have borrowed cheap money would have to pay back with dear money. It is extremely unlikely that the governments of the world can be reasonably expected to decrease appreciably the world inflation within a brief period of years."

Condition Not to be Avoided

The conditions that have brought about inflation and the rise in the price level in this country could only have been avoided if all trade relations with Europe had ceased at the outbreak of the war. What has happened has been that we have shipped enormous quantities of goods to Europe. These goods have not been used in production, but have been consumed or destroyed. We have received in return, not goods, but money. These transactions, in the aggregate, have approximated $15,000,000,000. Before the war this nation was indebted to Europe to the extent of $6,000,000,000. We are now Europe's creditor to the extent of $9,000,000,000.

A serious problem at the present time is concerned with the conditions surrounding future trade relations with foreign countries. If America continues to ship goods to Europe, receiving in return only money or promises to pay, there is danger that the disparity between the amount of commodities and the amount of money in this country will continue to grow, resulting in a level of prices even higher than that obtaining at the present time. In view of this, some people think to-day that it may become advisable to restrict exports to such an extent that they may be paid for in commodities rather than in money. Such a regulation could scarcely be put into effect all at once. It might not be practical at all. It would appear, however, that Europe's debt to us must ultimately be paid in goods.

Any consideration of future prices must necessarily involve a consideration of the probable tariff program. Without going into the controversial aspects of this subject, it is well that these phases of it which are likely to affect prices be noticed here. It is a serious question whether it is desirable that a tariff schedule be framed in such a way that we shall continue to ship goods away and receive in return only money or promises to pay. What used to be considered a favorable balance of trade, may not be considered so favorable in the future. The ideal condition in foreign trade is the exchange of commodities for commodiites, money being used merely as that which facilitates the exchange. It is true that it would not be desirable to have foreign goods sold in this country in such a way as to demoralize our markets. It is none the less true that we do not want further increases in our stock of money to such an extent that its purchasing power will continue to decline.

A Serious Problem

This problem is engaging the serious attention of some of the best informed leaders in business, economics and statecraft. It is to be hoped that their reasoned opinions will have a great influence on our future tariff policy. Even though past tariff policies may have been successful, any new policy must be framed after thorough consideration of a large body of new facts. A wise program can not be expected if it is made solely as a compromise between the claims of short-sighted, selfish interests. It can not be expected if the problem is viewed only in the light of before the war.

There are many far-sighted, thoughtful men among our leaders of business and our public men. There are men expert in this intricate subject among our practical economists. It is to be hoped that the ideas of these groups will prevail.

Although foreign trade relations have been so largely responsible for the conditions we face at present, and though these relations may be of great importance in the future, it is possible to concentrate too much upon the problems they involve. These problems can not be settled at once. France has been obliged to await the settlement of the Peace Treaty, and has deemed it expedient to place drastic restrictions on imports during the waiting period. Great Britain has raised the barriers against foreign goods for the duration of such time as is necessary to get her industrial house in order. The period of readjustment in Europe must be necessarily prolonged.

In the meantime, should the people of the United States sit idly by and watch their dollars shrink? Must prosperity wait until foreign markets are opened to us? When the wheels of American industry are turning and every able-bodied worker has a job that brings him a substantial wage, there is a pretty extensive market for American goods among the 110,000,000 people of America. The best way for Americans to set about arresting the shrinkage of the dollar is to produce more goods, thus remedying the existing disparity between commodities and money.

Prices of Building Materials

The shortage in the United States has been estimated at 1,000,000 houses.

At the beginning of the year the building of homes was urged on the grounds of patriotism. At present, it is an absolute necessity that they be built to fill an urgent need. Furthermore, in the light of present information concerning prices, it can be shown that money spent on building is money well invested.

Considered in relation to prices prevailing in the year preceding July, 1914, building materials are cheaper now than most other commodities. By the end of 1918 lumber had advanced 73 per cent. above the pre-war level; mill prices on Portland cement had risen, on the average, 74 per cent.; f.o.b. plant prices on mineral aggregate (sand, gravel and crushed stone) had risen, on the average, 73 per cent.; building stone, on the average, 64 per cent.; common brick, 92 per cent. The building materials group (not including any metal products) rose 84 per cent. Compare this with a rise of 113 per cent. in all other commodities, and with a rise of 116 per cent. in the group of farm products. The cost of construction of buildings on the average has increased about 62 per cent.

Little evidence is in sight pointing to a decline of prices in general. There is even less likelihood of declines in prices of building materials. The index for the group was the same for the first quarter of this year as for the last quarter of 1918. Slight declines in some materials have been offset by slight advances in others. As a group the prices have been practically stabilized.

In the nature of things, prices of building materials fluctuate less than the prices of those commodities which are consumed from day to day, such as foodstuffs and textiles, and of those commodities such as the metals, which furnish the raw materials of industry. During the Civil War building materials advanced less rapidly than did other commodities and they failed to reach the high levels of other commodities. In fact they remained above the general level of all commodities until 1874. If building materials, instead of fluctuating in price, had declined from the high point of January, 1865, at a uniform rate of 4 per cent. per annum until 1874, they would have reached their actual 1874 level, which was the general level of all commodities for that year.

Not Likely to Decline

A decline of 4 per cent. per annum in prices of materials would probably not involve an annual depreciation in value of a building of more than 2½ per cent. The fact is that present conditions do not indicate that the next few years will see declines in building material prices amounting to as much as four per cent. a year. It is more than likely that building materials, on the average will not decline at all for a considerable period. Present indications are that building

(Concluded on page 41)

FLAT RATE vs. METERS*

Comparison Between Operating Conditions Under the Two Methods of Charging for Water Consumed—Flat-Rate System Unjust to Consumers—Meters Profitable

By C. E. Abbott
Water Works Superintendent, Tuscaloosa, Ala.

THERE has always been some controversy as to the relative merits of conducting water works systems on a flat-rate basis and an all-meter basis, with conditions otherwise the same, and as to whether the benefits to be derived warrant the installation of the all-meter system. The owners and operators are practically unanimous in support of the meter system, while the consumers uniformly contend for the flat-rate basis; and this fact alone tends to show upon whose side the benefits of the meter system lie.

Of course, no criterion can be established for the entire country from statistics gathered in any one locality and, furthermore, it would be foolish for any one man to undertake from his own experience to prescribe the best operating methods for localities other than his own and operating under conditions with which he is not familiar. I have been manager of the water works system at Tuscaloosa, Ala., for about eight years. During this time the plant there has been operated first upon a flat-rate basis and later upon a practically all-meter basis, and I am therefore in position to give facts and figures by a comparison of which the many advantages of the meter system can be easily seen. However, I certainly do not wish to be regarded in the light of trying to tell other managers and superintendents how to run their business, or to insinuate that I know it all, or any more than any one else; but, having operated my plant under both systems and had opportunity to observe carefully the results of both operations, it has occurred to me that probably the figures covering these operations might be of interest to other operators who perhaps at this time find themselves under similar conditions as we were when we contemplated the change from the flat-rate basis to the meter basis.

From the Operator's Viewpoint

There are many advantages of the meter system over the flat-rate system that need no comparison to establish their validity. One of the foremost of these is the great injustice, to the consumers themselves, of the flat-rate system. Upon this slack basis one consumer may pay a stipulated amount for his water—based probably upon the number of openings—and probably use 5,000 cubic feet of water within a given time; while another consumer, with the same number of openings and paying the same basic amount for his water, could use 10,000 cubic feet of water within the same time and with no additional cost.

However, being a manager of a plant, of course, I am concerned chiefly with the operator's side of the matter, and it is the benefits and advantages to be derived by the operator himself that I propose to show in making a comparison of the statistics set out herewith, representing the operation of our plant first upon a flat-rate basis and latter upon a meter basis. Of course, the points of greatest concern to the operator are: Increasing the general efficiency of his plant, cutting down the amount of water to be pumped, cutting down the amount of fuel consumed—with the consequent decrease in operating expense—and increasing the revenue.

In 1911 the plant of which I am manager was operating upon a flat-rate basis. We commenced installing meters in the fall of 1913, with the idea of metering the entire system, which was practically completed in 1915. Beginning with the year 1916 the plant was operating upon practically an all-meter basis. Therefore, by a comparison of the statistics covering the operation during these two years, the effect of the installation of the meter system can be shown; and by this comparison I propose to show how the amount of water pumped per day in 1911 under the flat-rate basis was decreased in 1916 under the meter basis by about 27%, notwithstanding the fact that there was an increase in the number of consumers in 1916 of about 65%, and how the amount of coal consumed in 1911 was decreased by about 170% in 1916, and the operating cost decreased proportionately.

*Excerpts from a paper read before the annual convention of the American Water Works Association at Buffalo.

Operating Conditions in 1911

The general conditions under which the plant was operated in 1911, and the equipment, were as follows:—

The power plant is situated upon the banks of the Warrior River, about three miles above the city of Tuscaloosa, Ala. The plant is situated upon an incline—the settling basin being above the plant and the water flowing by gravity through slow sand filters to the clear-water basin below the plant. The water was pumped from this clear-water basin to a stand-pipe in the city—the tank having a capacity of 125,000 gals. and an elevation of 100 ft. The pumps were operated twenty-four hours a day, working against a pressure of 165 lbs. at the plant. The actual equipment consisted of three 72-in. by 16-ft. return tubular boilers; two horizontal compound, non-condensing Worthington pumps—alternating in operation weekly. The cylinders were:—High pressure, 16 ins.; low pressure, 25 ins.; water plungers, 11 ins.; stroke, 15 ins.; rated capacity, 24 gals. per stroke. The water pumped in 1911 is figured on the delivery of these pumps, allowing 10% for slippage.

The figures covering the operations during the year 1911 are as follows:—

Number of consumers at end of 1911:—	
Flat rate	927
Meter	42
Amount of water pumped during entire year	317,335,980
Average amount of water pumped daily	869,413
Number of tons of coal used during the year	3,285

Cost of coal $2 per ton.

General Conditions in 1916

The general conditions under which the plant was operated in 1916, and the equipment, were as follows:—

The operating conditions in 1916 were the same as in 1911, with the exception that a new reservoir had been built within one-half mile of the power plant. It is 62 ft. high and 75 ft. in diameter, constructed of reinforced concrete. This reservoir was planned and built by Morris Knowles, of Pittsburgh, Pa., and is a magnificent piece of engineering work. Also a new high-service pumping engine was added: Type, Myer; gear flywheel; high pressure cylinder, 14 ins.; low pressure cylinder, 30 ins.; water plunger, 10¼ ins.; stroke, 24 ins.; condensing; rated capacity, 30 gals. per stroke; manufactured by Laidlaw Dunn Gordon Company. The amount of water pumped in 1916 is figured on the delivery of this pump, allowing 5% for slippage. The number of pumping hours was reduced in 1916 to an average of 10 hours per day.

The figures covering the operations during the year 1916 are as follows:—

Number of consumers at end of 1916:—	
Flat rate	190
Meter	1,414
Amount of water pumped during entire year	230,779,985
Average amount of water pumped daily	632,274
Number of tons of coal used during the year	1,215

Cost of coal $1.95 per ton.

Comparisons, 1911 and 1916

Total number of consumers in 1911	969
Total number of consumers in 1916	1,604
Numerical increase in number of consumers	635
Representing an increase of 65% plus.	
Amount of water pumped during 1911	317,335,980
Amount of water pumped during 1916	230,779,985
Numerical decrease in gals. pumped	86,555,995
Representing a decrease of 27% plus.	
Number of tons of coal used during 1911	3,285
Number of tons of coal used during 1916	1,215
Numerical decrease in number of tons	2,070
Representing a decrease of 63% plus.	

All the above figures are taken from the records of the City Commission of Tuscaloosa, Ala., and can be verified upon inquiry.

Best Check on Operation

From a standpoint of efficiency, and in order to check the operations of the plant, it is essential that the operator account for, so far as is possible, all the water that is pumped; and it is unquestionable that the meter system provides the best method for this. However, notwithstanding all the benefits derived from the employment of meters, even where the meter system is employed, certain conditions arise in which it is not practicable to use meters. It will be noted that while employing the meter system almost entirely, we still have 190 consumers receiving water on a flat rate. This condition arises from the fact that these 190 consumers live outside the sewer zone and have each only one opening on the premises, and twenty meters placed on consumers under identically the same conditions show that 50% of the minimum allowed under the flat rate is never reached.

With the meter system in operation during the year 1916 we were enabled to account for 85.8% of all the water pumped during the year. These figures would be higher but for the fact that we had no way of accounting for the water used in fighting fires, and the amount used in street flushing, sprinkling, etc., is purely an estimate based upon the capacity of the tank, and the estimate is in fact considerably below the amount of water actually used for these purposes. The figures in substantiation of this are as follows:—

Where the Water was Used

Total meter reading for domestic consumers ..	114,186,477
Total meter reading for mannufacturers, etc. ...	59,144,425
Total meter reading for filter wash water	9,552,660
Total meter reading for schools	2,920,460
Estimated amount used in street sprinkling, etc.	11,182,000
Total amount of water accounted for by records	196,986,022
Total amount of water pumped during year ..	230,779,985
Water unaccounted for	33,793,963

Representing a percentage of only 14.2% of the total amount pumped as being unaccounted for.

Lockwood, Greene & Co. of Canada, Ltd., industrial engineers, have opened an office in Montreal. E. G. Horne, formerly of Grant & Horne, contractors, of St. John, N.B., is the manager. The head office of the parent company, Lockwood, Greene & Co., is in Boston.

The Association of Canadian Building and Construction Industries called a meeting of its national council to be held last Monday in Ottawa in order to meet representatives of the government and of organized labor, for a general discussion of the labor situation. About seventy-five labor delegates and approximately an equal number of employers were expected to be in attendance.

The question of a general sewerage system for the municipalities of St. Lambert, Lougueuil, Greenfield Park and Montreal South, has been before the Quebec Public Utilities Commission. Messrs. Lea and Duchastel, engineers appointed to prepare plans, reported that there was a difference of opinion between the municipalities as to the location of the outlet and the engineers recommended that it be placed about 1,600 ft. out in the river, just below the government wharf, at a point known as St. Antoine's Creek. F. W. Cowie, engineer for the Harbor Commission, objected to this location on the ground that it might interfere with the future plans of the Commission, and that the situation is one where the outlet would be menaced by ice. Objections to the site proposed were also made by representatives of the municipalities interested. The engineers were instructed to continue making tests as to the current and ice conditions, whether the outlet should be temporary or permanent, and also as to whether it would be advisable to construct the sewer of greater strength than was at first proposed.

BOND PREMIUMS ON GOVERNMENT CONTRACTS*

THE form of "cost-plus" contract used by the construction division of the United States War Department during the war provided under the heading of "Cost of Work" for reimbursement of the contractor's actual net expenditures. Among the various items was the following:

"(h) Such bonds, fire, public liability, employer's liability, workmen's compensation and other insurance as the contracting officer may approve or require."

Article IX. provided that:

"The contractor shall, prior to commencing said work, furnish a bond with sureties satisfactory to the contracting officer."

Notwithstanding these provisions, the comptroller of the treasury has recently held that the form of cost-plus contract in use by the construction division does not authorize the reimbursement to contractors of the cost of premiums on their bonds. This ruling has been adhered to in the face of strong objections by the chiefs of the construction division.

Association Secures Legal Assistance

Upon inquiry of representatives of the construction division, it is ascertained that it is quite certain that all contractors having unsettled contracts for work under that division and money due them under such contracts will now have deducted from any balance due them the sum of all payments heretofore made to them covering reimbursement of premium on bonds. This will probably include not only their unsettled contracts but such payments made upon other contracts of this class upon which settlements have already been made. It is not possible to say whether those who have no current construction contracts will be called upon to refund all such sums heretofore reimbursed to them. This will depend upon the discretion of the disbursing officers of the war department and the orders of the accounting officers of the treasury.

This matter is one of wide importance to contractors and accordingly the officers of the Associated General Contractors of America have taken up the subject for conference with King & King, attorneys, Washington, D.C. As a result of very careful consideration, the following suggestions are made:—

If the amount of premium bonds already is deducted from moneys otherwise due upon current contracts, the contractors should accompany the voucher covering any such payment and showing such deduction with a letter containing substantially the following language:—

"It is to be understood that in accepting payment evidenced by the attached voucher under our contract of ..... for constructing ..... we do so without in any wise waiving our legal rights to full reimbursement under the terms of our contract of all sums paid by us as premium on bonds. We expressly reserve our rights to reimbursement of all sums paid by us on such account."

This letter should be pasted to the voucher.

Refuse Demands for Refunds

Those who are called upon to refund any payments of the kind noted should decline to do so abolutely and leave the government to take such action as it may deem advisable looking to a recovery.

The attorneys named have given us their opinion that the contracts entitle the contractors to reimbursement of these premiums, that the deduction is unlawful, and that it can be recovered by future proceedings in the treasury department or before the court of claims.

The opinion of the comptroller above referred to was given as an advance opinion to several disbursing officers. This will govern the action of all disbursing officers for the future, but it is not conclusive even in the comptroller's office. The matter can be brought before the comptroller again upon a claim duly presented by any contractor. This claim must be filed with the auditor for the war department and will

*A circular letter mailed to members of the Associated General Contractors of America.

be disallowed by him and then appealed to the comptroller. The comptroller will then hear legal argument upon the merits of the question. The opinion already rendered will be considered by him as prima facie correct, but he will not hold it to be finally binding upon him, if convinced to the contrary by any arguments then presented to him. There are numerous precedents for the comptroller reversing, in a claim thus brought before him, an advance opinion rendered to a disbursing officer.

Will Conduct Test Case

Should the comptroller decide this test case favorably, the other claims will be paid. If the comptroller adheres to his unfavorable decision, a test case can then be taken before the court of claims. If the court of claims decides in favor of the contractor in the test case, the comptroller will probably reverse his decision and allow other claims of the same nature, if they have not already been brought before him and adversely decided.

It is also possible to test this question by insisting upon a suit being brought against a contractor by the United States. It may be thought best to take this course, but at present it is thought best to make the test by a suit in the court claims.

It is not probable that any contractors will be pressed for payment of premiums already paid to them under settled contracts unless a decision should be rendered by the court of claims adverse to them. Such a result is not expected. If that is adverse, there will still be an opportunity for defense to such claims under the provision of Article IV. of the contract, providing that the monthly statement of costs and "all payments made thereon shall be final and binding upon both parties hereto."

Independent Action Not Desirable

This association expects to take up this matter as an association matter on behalf of the contractors interested. Nearly all of them are already members of the association and it is hoped that all others interested will join the association in order to bear their fair share of the movement. It is very important that contractors should leave the handling of this matter to the association, as independent action may interfere with the orderly handling of the test case in the manner above outlined.

ADVANCE IN BOOK PRICES

ANNOUNCEMENT is made, to take effect immediately, of an advance of $1.00 per volume in a number of $5.00 handbooks published by the McGraw-Hill Book Co., of New York City. The company states that the increase from $5.00 to $6.00 is necessitated by the steadily increasing cost of labor and materials.

Readers are also reminded that announcement was made recently by another very prominent New York publisher, John Wiley & Sons, Inc., that an increase in the prices of a number of their books would go into effect August 20th.

All orders received by *The Canadian Engineer's Book Department* for McGraw-Hill books will now have to be at the new schedule of prices, but all orders for Wiley books received in time for transmission to New York before August 20th, will be taken at the old prices.

Great interest is being shown in Japan in the development of the hydro-electric industry, according to M. Nakamura, of Tokio, an electrical engineer who is travelling through Canada in the interests of his profession. At present, the development of 1,000,000 h.p. is contemplated or under way. The production of electrical equipment is sufficient to care for domestic requirements. Electric heating, which is the department in which Mr. Nakamura is most interested, is proving productive of an unusually heavy demand for equipment, and heating appliances will have to be imported in large quantities, he says.

WATER POWERS OF BRITISH COLUMBIA

ARTHUR V. WHITE, consulting engineer to the Commission of Conservation, recently completed a report on the water powers of British Columbia. This report, which will soon be issued by the Commission of Conservation, estimates the total 24-hour horse-power of the water-powers of that province at about 3,000,000 h.p., in round figures.

Mr. White's report completes the series of water-power reports which the commission in 1910 undertook to publish. The British Columbia investigation was commenced in 1911.

Referring to the difficulties experienced in obtaining the data in the report, and to the conditions affecting water-powers in the province, Mr. White says:—

"The season available for such reconnaissance water-power investigations as were made in British Columbia is comparatively short. One of the chief difficulties encountered is that it is almost impossible for observers to avoid over-recording in their notes the power possibilities of stream observed during high-water. Young engineers are impressed by the quantity of water coming down the rivers, and have not the advantage of having observed the same streams at their low-water stages, nor have they always the knowledge of measurements of the flow of similar streams to temper their judgment.

Power Conditions are Unique

"The conditions affecting powers in the province are unique, and do not closely correspond to those existent in other portions of Canada. This is especially true of the mainland Pacific coast. One cannot but be impressed with the fact that coastal water-powers in British Columbia, which to the casual observer appear to be of comparatively small amount, nevertheless may, when economically and fully developed, yield several-fold the estimate of power, if appraised upon the same basis as similar streams in Eastern Canada. Glaciers, snowfields, and heavy rainfall abound, and, with many storage possibilities, constitute unique factors which contribute to enhance the values of powers. These conditions, on the other hand, emphasize the necessity of special and very careful engineering investigation and expert handling."

Power site tables giving summarized data with regard to the various water-powers, are given in the report, which says, in reference to these tables:—

"Owing to the topography of British Columbia and the relative small extent of territory covered by detailed topographic and hydrometric surveys, it is practically impossible to make anything like a close estimate of many of the water-power possibilities. Both the confines of the watersheds of many of the available streams and their run-off are unknown. In such cases any figure purporting to give the available amount of power is at best only an estimate indicating possibilities.

Three Million Horse-Power

"The power tables contain summarized statistical data regarding the water-powers. It is not practicable to indicate any details of information upon which the tabular estimates are based, but all available data have been used. Effort has been made to keep on the conservative side, and totals for the province, based on the tabulated estimates, can only fairly be compared with estimates for other large territories by taking into account the conservative character of the deductions. . . . Estimated quantities are on the basis of 24-hour horse-power, 80 per cent. efficiency. If comparison is made with other estimates of horse-power giving theoretical quantities, then our estimates should be increased 25 per cent."

Following is the estimate of the powers in the province, which has been divided into districts for the purposes of the report:—

	24-Hr. Power.
1. Columbia River and tributaries (north of the international boundary): This comprises the portion of the province lying between its eastern boundary and the watershed of the Fraser River	610,000 h.p.

2.	Fraser River and tributaries: This includes practically the entire area of the great interior plateau	740,000 h.p.
3.	Vancouver Island	270,000 h.p.
4.	Mainland Pacific coast and adjacent islands (except Vancouver Island): This includes all the rivers north of the Fraser, which drain into the Pacific	630,000 h.p.
5.	Mackenzie River tributaries (a rough estimate made for inclusion in this summary)	250,000 h.p.
	Grand total,	2,500,000 h.p.

The above total includes about 250,000 h.p. for plants already in operation, but it does not include about 400,000 h.p. for power possibilities on streams like the Fraser, Thompson, Skeena and Naas Rivers on which, because of the proximity of railways or possible interference with the salmon industry, economical development cannot be considered under present conditions. Also there is still considerable territory, especially in the northerly portion of the province, which it has not been possible to investigate fully. These areas may yet disclose a considerable amount of power, says Mr. White.

HOW TO REDUCE RISKS IN EARTHWORK*

By Halbert P. Gillette

FEW classes of construction are so difficult to control economically as earth excavation. Rainy or freezing weather may completely upset the best-laid plans and cause a severe financial loss. Usually most of the working gangs are common laborers, quite irresponsible, quitting at the slightest provocation, often with no provocation.

The character of the earth itself may vary greatly from week to week, or even from hour to hour. The length of haul is seldom constant, even for one day. Small wonder, then, that no ordinary class of contracting is more hazardous than earthwork.

Experience Necessary in Estimating

The first great risk is taken when the estimate is made as to the classification of the excavation. Here it is that experience counts so much in favor of an older man, and lack of experience hits a younger man so hard. But a young contractor is not necessarily without means of self-protection. He can employ an experienced superintendent, he can dig test-pits and make earth soundings.

When I first went into the contracting business I soon learned never to bid on excavation until I had "prospected" the job pretty thoroughly. It is surprising how much can be accomplished in a short time in this manner.

Sounding with rods is an expeditious way of ascertaining the depth to ledge rock or to hardpan, and it will also disclose the existence of boulders. But in an unfamiliar country it often is necessary to dig test-pits or small wells, so that the toughness of the earth can be judged by observing the resistance to a pick.

Often there is insufficient time to prospect the ground thoroughly. Then, if the work is in a section where your experience has been limited, don't bid at all if the earthwork is extensive.

Prospecting for Facts

Some years ago, a firm of young contractors in New York City asked me to assist them in estimating the cost of a large job of excavation in New York State. The cuts and fills were heavy, and the engineers had made no soundings. The engineers had estimated that the excavation would be 75% solid rock and 25% earth. After walking over the line, I asked one of the contractors what he thought of the "three to one" classification the engineers had made. He replied that it seemed to be "any man's guess," but that he presumed the engineers were approximately right, as they had been engaged for months on the surveys and in planning the construction. Had he known more about common engineering practice, he would have had little faith in that guess as to classification. I explained to him that about the last thing that the average engineer does on such a survey is to estimate the classification, and that then he usually guesses, often wildly. "Well," said the contractor, "we want to bid on the job, and it's too late now for us to do more than guess also." He was surprised when I assured him that in the two days remaining before the bids would be opened, we should be able to estimate pretty accurately what percentage of the excavation was solid rock. Since many of the cuts were 50 to 60 ft. deep, and quite long, it looked like an impossible job to do much sounding in two days; as for adequate test-pit sinking, that was impossible.

Boulders, Not Solid Rock

Jutting from the surface of the earth at frequent intervals was rock (gneiss) that appeared to be ledge rock, and it was this appearance that had led the engineers to estimate 75% solid rock. I pointed out to the contractor that ledge rock in southern New York State is usually grooved in a north and south direction as a result of the grinding action of ancient glaciers; but that none of the outcropping rocks that we had seen on that job were grooved or scratched in that regular manner. Hence they probably were boulders. There were other geological facts that led me to the same conclusion, but it remained to prove the inference beyond doubt.

I had noticed along the line several wells that supplied water to farmers, and these, I believed, would be rather deep-dug wells—real test-pits for our purpose. We were able to find the men who had dug some of these wells, and to learn from them that they had dug 50 to 80 ft. without striking solid rock, and that they had encountered few boulders.

In order to confirm this testimony, we put several small gangs of laborers at work sounding with rods. The results of that sounding showed that there was no ledge rock at all in any of the cuts. The subsequent excavation proved this conclusion to be substantially correct.

Naturally, these contractors bid a fairly stiff price on earth and very low on rock, and were the lowest bidders.

Adequate Plant Reduces Weather Risk

In estimating both the classification of excavation and the toughness of the materials, any nearby cuts should be examined; and local men who have done any excavation should be interviewed.

Having secured the job, it is important to reduce the bad weather risk by starting excavation as quickly as possible, and by using enough plant to rush it through before the autumn rains start. Here it is that the inexperienced contractor is apt to err. He may not order all his plant until he signs the contract; then he usually orders neither enough plant nor spare parts. Delays occur in getting the plant on the job, and several weeks of good weather may be lost before the work is going "full swing." Even then the "swing" is not "full" enough because of pennywise attempts to save money on plant investment.

I recall that a certain contractor on the deepening of the old Erie Canal in 1896 made a profit where his neighbor contractors lost money, simply because he brought, begged and borrowed a lot of equipment so that he was able to finish before the ground froze.

Have a liberal surplus of plant capacity, for surplus plant is the best investment on an earth-moving job.

Fit the Plant to the Job

The next important risk to eliminate is the risk of using a relatively uneconomic method or machine. There is no better way of reducing this risk than by having daily, weekly and monthly reports of the yardage moved by each

(Concluded on page 41)

*From "Engineering and Contracting," Chicago.

STANDARDIZATION*

By Guilliam H. Clamer
Vice-President, Ajax Metal Co., Philadelphia, Pa.

THERE was a time when the candle maker and the candlestick maker each made their wares to suit their own inclinations. As a consequence, seldom did the candle user find that the candle would fit his particular candle-stick. Time, in the days of candle illumination, was, however, not so precious as it is to-day, and a little more or less time consumed in shaving down its end, if the candle was too large, or if too small, in whittling a wedge to support its base. was of little consequence

It nevertheless finally dawned upon these two classes of manufacturers that if they were to get together and standardize the size of the candles, and also make the sockets of their candle-sticks of such dimensions that the candle would properly fit, time would be saved, annoyance prevented and convenience promoted. This is one of the early examples of standardization and it has been referred to by Sir Joseph Whitworth, one of the early workers in the field of standardization, and the introducer of the series of screw threads known as the Whitworth standard.

Standard-Gauge Railway Construction

There was a time, not so long ago, when there was no United States standard track gauge for our railroads. Without standardization of track gauge it was impossible for the equipment of one railroad to be used on another. It has only been through standardization of track gauge that interline transportation has been made possible. We now travel in the greatest comfort from one end of the country to the other without a change of cars. A freight car may be loaded in Maine and without transfer of its cargo arrive in San Francisco or Key West. In fact, it may even be loaded on a barge at Key West and transferred to any part of the Island of Cuba over United States standard-gauge track.

At the present time very active progress is being made in railroad building in South America and Central America, and very shortly activities in the line of railroad building will be again resumed in Mexico; and it can be confidently expected that a Pan-American Railroad, extending from any part of the United States to Argentina, a distance of ten thousand miles, will become a reality. It is unfortunate, in this stupendous undertaking, that all sections of this railroad should not be of standard gauge. A large part of the trackage in the southern countries, as at present built and under contemplation, is of gauge which differs from our own.

I do not believe that there is one single effort which can be taken in bringing countries of the western hemisphere into closer relationship than the building of a standard gauge railroad over this entire distance.

Pipe, Screws, Bolts, Nuts, Etc.

There was a time, within the memory of the present generation, when there was no such thing as standard pipe sizes or threads; and, even more recently, when there were no standard machine screws. Each manufacturer had his own special threads. Selfish interests were so strong and the vision so narrow that great opposition on the part of the manufacturers prevailed against standardization of screw threads. Each manufacturer wished to compel the user of his machines to come to him for repair parts. He did not realize that his business interests were impaired if a user of his machine suffered inconvenience and perhaps financial loss by the shut-down of the machine because of the necessity of sending to the factory to get the necessary repair part.

There is at present before congress a bill which proposes to extend the life of the commission to standardize screw threads, created under the act of July 18th, 1918. Governmental action has in the past legalized other standards. The first attempt at standardization of screw threads, bolts, nuts, etc., was made in 1864 by a committee of the Franklin Institute of Philadelphia. This committee recommended the adoption of the system known as the United States Standard which was devised by William Sellers. In 1906, the Association of Licensed Automobile Manufacturers adopted standards for automobile screws and nuts, and a year later the American Society of Mechanical Engineers accepted the report of its committee on standard proportions for machine screws. The screw threads adopted by this society differ only in very minor details from the Sellers or U. S. Standard. This report specifies tolerances and includes standards for taps, special taps, special screws and screw-heads of various types. In 1912, the Society of Automobile Engineers enlarged their number of standards.

An act of congress in 1893, established a standard gauging system for sheet iron and steel. This was a purely arbitrary standard. Other arbitrary gauges are in use for wire and drills as well as for sheets. The only rational system is the decimal system in which the gauge number is expressed in thousandths of an unit.

There is a long list of further standardization work which has had its stimulating effect upon industrial progress, but these few illustrations I have given are sufficient to emphasize the importance and magnitude of this line of endeavor.

Only within the present century has standardization in manufacturing processes, methods and practice been seriously pursued and so-called scientific management inaugurated. Industrial progress owes much to the adoption of such standardization. In the automobile industry particularly we have out-classed the world because of such standardization. The adoption of standardization to shipbuilding during the war has put America, within two years time, in the first rank in this industry.

Quantity production can be realized only by reason of such standardization, and at the time of the signing of the armistice, quantity production in the manufacture of our airplanes was well under way and history will no doubt reveal the fact that this was quite instrumental in bringing our enemies to the realization that it was futile to further pursue the war.

Conservation Division, War Industries Board

During the war conservation of our resources became an absolute necessity and the work of the conservation division would have had far reaching effect had the war continued. The conservation division was organized to perform the function, which was expressed by the president in his letter to Mr. Baruch, as "the studious conservation of resources and facilities, by means of scientific, industrial and commercial economies, to meet war requirements."

The necessity for such standardization, as a war measure, was unquestioned, but just how far such standardization, in peace times, would be economically advantageous or economically detrimental, is speculative. Consumers are willing to pay for selection and for the gratification of their individualistic tastes as to style, color, form, etc. It is this fact which, in a very great measure, has resulted in the enormous number of commodities, differing in only slight degree from each other, now being offered on the market. A reference to but a few typical examples of our war-time conservation will be of interest in pointing out the wonderful possibilities in this direction.

Pneumatic tires, reduced from 232 styles to 9; solid rubber tires, 100 styles to 15; steel pens, 700 to 300; china and crockery, from 1,696 pieces to 330; 5,500 styles of rubber footwear discontinued, meaning a yearly saving as follows:—

29,012,600 cartons,
5,245,300 sq. ft. of lumber,
4,795 tons of freight,
1,526,423 cu. ft. shipping and storage space,
2,250,272 lbs. of material that will not have to be dyed,
74,750 lbs. of flour and starch,
30,380 gals. of varnish,
125,300 lbs. of tissue paper,
49,617 days of labor.

*Presidential address at the annual meeting of the American Society for Testing Materials.

Consider such a matter as the method of packing thread. If marketed with 200 yds. to a spool, instead of 100 and 150, there would be saved 5,146,815 ft. of lumber or 365 carloads. The saving in shipping space of finished product is about 600 cars, in wrapping paper 3½ tons, and in twine, 5 tons. Had the yardage been reduced to 100 yds. per spool it would have required over 600 cars to transport the lumber, so that the total saving is 1,200 cars by using the 200-yd. spool.

With these few examples, it can be readily realized what tremendous savings might be effected if a safe and sane policy of standardization was put into effect through co-operative agreements. It means lower cost of production, smaller capital investment, etc., with a greater amount of capital released for more useful purposes.

Research and Standardization

Emerson's definition of a standard is as follows: "That which is established by investigation or authority to be a reasonably attainable maximum of desirability."

Research and standardization should go hand in hand, but the body controlling the former should not also dominate the latter. Research should point out the ideal, namely, the highest standard of excellence which should be approached as nearly as possible by the approved standard. The final specification must of necessity be a compromise between consumer and producer, the consumer demanding the nearest approach to the ideal, and the producer agreeing to that which is commercially possible, cost, rapidity of production, service requirements, etc., all having due consideration.

Standards Often Must Advance

Research bodies should never be satisfied that the ideal which they have set up is final, otherwise practice becomes crystallized and invention discouraged. What if the locomotive of twenty years ago, or even ten years ago, were to have been considered a final standard? What if the standard locomotive or standard cars recently adopted by the U. S. R. A. Committee were to be considered a final standard, or if the automobile of but a few years ago were no further improved upon? Such standardization, if not constantly open for revision, would, instead of benefiting the industries and mankind in general, actually do a positive harm.

Unfortunately, many standards have been adopted without a proper knowledge or without due consideration, and when such standards are once established it is exceedingly difficult, costly and inconvenient to abandon them. The one great shining example of this was the adoption of our cumbersome and unsatisfactory system of weights and measures.

Recommended D.C. for Niagara Power

When the great Niagara Falls power plant was to have been installed, expert opinion was secured to recommend whether direct or alternating current systems should be used. This was at a time when alternating current systems were quite new. Lord Kelvin, a great authority, recommended the installation of direct current apparatus. In the light of our present day knowledge on this subject, just think what a tremendous mistake that would have been. When it was finally decided to install alternating current, Professor Roland, of Johns Hopkins University, was consulted regarding the nature of the alternating current which should be used. After a painstaking investigation he recommended that current be delivered at 25 cycles. It, therefore, so happened that the expert advice that was followed in the installation of that plant resulted in the establishment of a standard for the current supply which has stood the test of time. In such an installation there is involved not only the power plant itself but all the existing circuits and equipments connected therewith, and it may therefore be realized how costly and inconvenient it would be to change, in a case of this kind, from one standard to another.

It frequently pays to adopt new standards, notwithstanding the expense involved, rather than to continue with an old standard which is evidently wrong and inefficient. Many examples exist in machine design, and in the standards adopted by the Master Car Builders' and Master Mechanics' Association and other standardizing bodies which are universally acknowledged as poor; but as the equipment has been built up about such standards and as to change would result in an enormous cost, they are unfortunately continued.

Cost Accounting and Industrial Co-Operation

Some time ago the New York milk dealers asked for an advance in the selling price of their commodity. They were unable to show the actual cost of milk delivered to the consumer and were therefore not in position to substantiate their demands. Investigation revealed the fact that adequate and reliable cost-keeping systems are rare. Some attempts have been made in certain industries to establish standard cost-keeping systems—the American Foundrymen's Association has a committee on the subject. They have retained an expert who acts in an advisory capacity to its members.

The cast-iron stove manufacturers have done the same. It was found that two manufacturers producing an identical line of stoves, exhibited widely different costs for the different types. A certain small type was sold by one manufacturer below the cost price of another, whereas, a larger type could not be produced by this same competitor at the latter manufacturer's selling price. The explanation is simple, namely, they used different methods for distributing costs.

With a standard cost-keeping system within an industry, all would be benefited because all comparisons of the many items going to make up the cost would be upon an equal basis. A most important assistance could be rendered our industries if there should be organized a National Bureau for Establishing Cost Systems, the function of which should be to investigate the accounting systems in vogue in the industries, and to render assistance in the establishing of standard cost accounting.

During the war startling facts were revealed in this connection. The cost, as submitted by different manufacturers, on the same specification were so widely divergent that upon the "cost-plus" basis the government would have been called upon to pay widely varying prices for the same commodity. The need for standardization in this connection is so apparent that the United States Chamber of Commerce at a recent convention passed a resolution favoring a system of uniform cost accounting in each industry. This resolution had the endorsement of approximately 3,000 men representing all lines of commercial and industrial interests, and emphasizes the growing desire and tendency of industrial leaders to do away with the rule of guess and gamble and to establish their industries upon the science of correct and adequate records and account. It is only by such means that the present day gross inefficiencies will become recognized and eliminated. True advancement in industrial management and operation can best come through industrial co-operation; it would be a pity to allow the fruits of the co-operation which was established during the war to be wasted now because of the throttling power of the now generally conceded unwise legislation which was enacted some years ago, namely, the so-called Anti-Trust Laws.

Benefits Capital and Labor

The value of industrial co-operation was well recognized and greatly encouraged by the government during the war. Without such co-operation the wonderful productive capacity of our industrial establishments could not have been availed of to its fullest extent. Through standardized conditions, standardized records and standardized accounting, industries can be brought under intelligent government supervision and control. It would thus only be possible for such co-operation to proceed and be encouraged without doing final harm to the public. In fact it would lead to the decided benefit of labor and of the public as well as to capital.

To emphasize the attitude of the present day in this connection, I will quote a resolution of the United States Chamber of Commerce, recently issued by that body, which so strongly represents our American industries:—

"Resolved: The war has demonstrated that through industrial co-operation great economy may be achieved, waste eliminated and efficiency increased. The nation should not forget, but rather should capitalize these lessons by adapting effective war practices to present conditions through permitting reasonable co-operation between units of in-

dustries under appropriate federal supervision. The conditions incident to the period of readjustment render imperative that all obstacles to reasonable co-operation be immediately removed through appropriate legislation."

International Standardization

Standardization is the keynote to convenience, comfort and efficiency. We are so accustomed to the use of our fundamental standards, weights and measures, expression in language, national currency, postage, etc., that we do not fully realize what the establishment of such standards means to us individually, and to our national prosperity. Were each state to have a different language, a different standard of weights and measures, etc., we would not now be united into a vast and prosperous country. There is nothing that will promote international trade co-operation and good fellowship so much as would the establishment of wise and mutually satisfactory standards, some of which may be classified as follows:—

1. *International Language.*—National jealousies would no doubt prevent the adoption of any of the existing languages, unless the power of the nations now using such language should become sufficiently strong to enforce it. Germany, in her deep-seated plans to rule the world, had done all in her power to establish the German language in schools and colleges of many lands. Had her plans succeeded, the German language would no doubt have been enforced upon the world as it was in Alsace-Lorraine after the war of 1870.

The English language has long been the prevailing language in the world of commerce, and with the now still greater alliance of the Anglo-Saxon races will no doubt be extended. The English language as a standard leaves much to be desired when compared with the ideal; simplified spelling would help materially. The commercial advantages which would accrue temporarily (one generation at least) to the English speaking people of the earth, were the English language to become standardized, would be so great that such adoption would be sure to be frowned upon by all other nationalities. This being a fact, two entirely neutral languages have been proposed; these proposed languages being purely artificial, one knows as Volapük, meaning "world speech," published in 1879, and the other Esperanti, named for its originator, proposed some years later.

Artificial World-Language Needed

The International Congress of Philosophy, which met in Paris in 1900, defined the following essentials with which such an artificial language must comply, namely:—

The language shall serve the needs of daily life and business as well as the requirements of science and learning.

The language shall be so simple that a person possessing an average common school education can acquire it readily.

No doubt efforts will now be renewed toward the establishment of a standard system of expression for world-wide use.

2. *International Religion.*—Two hundred and sixty-eight religious sects, past and present, are recorded. About one-third of the population of the globe are followers of Buddha. Many Christian denominations differ from one another mainly on interpretation of the Bible.

During the World's Columbian Exposition in Chicago in 1893, a Congress of Religions was held. It was attended by representatives of the Buddhists, Mohammedans and other Asiatic religions, as well as by all Christian denominations. No effort was made at that time toward the establishment of a universal religion, but the possibility of establishing such a religion has been much commented upon since that time, and especially since the beginning of the great world conflict, which was participated in mainly by the followers of the Christian religion, each of the contestants praying to the same God for victory.

The Utopian of yesterday is the commonplace of to-day, the dream of to-day is the reality of to-morrow. We are prone to forget that our own short life-time is but as a small fraction of a second in eternity and we strive, in our imagination at least, to crowd into that small period of one generation the reforms for which the world will be ready only many generations hence.

These two subjects for standardization, that I have just discussed, would hardly seem befitting in our present highly practical age, and especially before a society which deals only with the strictly concrete subject of engineering materials. The standardization of language and religion is looked upon to-day as absolutely idealistic, but I feel very safe in predicting that in some future generation they will surely be a reality. I will now proceed with the more concrete subjects for standardization.

3. *International System of Weights and Measures.*—All are agreed that the metric system is ideal. It is in use by every civilized nation with the exception of the United States and Great Britain and some of her colonial possessions. An association, having as its object the world-wide adoption of the metric system, is in existence. This association, known as the Metric Association, is at the present time taking advantage of the world-wide desire for closer co-operation by carrying on a strong campaign for the adoption of the metric system in England and in the United States.

"Metric System" British Invention

The old German Osterling-Hanseatic League, which for hundreds of years controlled the trade of England, introduced the British pounds, both sterling and avoirdupois. We fell heir to these standards, which had been forced upon the British, through the British possession of a large part of the United States prior to the revolutionary war.

It was James Watt, the eminent scientist of Great Britain, who invented a few years after the American revolution, the decimal system of weights and measures now embodied in the metric system. Unfortunately, we did not adopt the Watt system in the early days of our independent existence, neither did England adopt it notwithstanding the fact that it was a British invention. Germany, however, soon after the war of 1870 did adopt it. Germany, during its war with France, having acquired a closer familiarity with the decimal system, was brought to a realization of its superiority over their own system. The metric system is referred to as the French system because of the French unit (the meter) employed.

To change from one system of weights and measures to another is no easy matter and it is exceedingly costly. The advantages, however, to be gained are so far reaching that the loss occasioned would be soon wiped out. We are to-day suffering because of the unfortunate choice and adoption years ago of a cumbersome system. To rid ourselves of this is analogous to taking a large dose of quinine, bitter and disagreeable, but nevertheless effective, with the patient better off for having taken it.

4. *International Standard of Temperature.*—How absurd is our Fahrenheit scale, and how confusing to have one scale for scientific expression and another for commercial usage.

Other Suggested International Standards

5. *International Coinage System.*—Why not a system of coinage, as well as a system of weights and measures, based on the principle of the divisibility by ten?

6. *International Gauging System.*—How perfectly absurd are the various systems based upon numerals having no particular significance. The only scientific manner in which to express gauge thicknesses for sheet, wire, cable, etc., is in the decimal system, using preferably the metric unit.

7. *Miscellaneous Standards.*—In addition to the above standards, other standards such as screw threads, electrical rating, power rating, etc., can be internationally adopted. Already some progress in these directions has been made by the co-operation of the British Standards Committee and the American Society of Mechanical Engineers, American Institute of Electrical Engineers, and through other co-operative work.

8. *International Standards of Material.*—So long ago as 1898, there was organized in Philadelphia the American section of the International Association for Testing Materials, which section was later incorporated as our present

society, which then became affiliated with the International Association for Testing Materials. Unfortunately, the International Association was opposed to the formation of international specifications for materials, and did not encourage the organization of strong national groups. It is questionable, if it is practicable or desirable, to revive the old International Association.

In this connection, at its quarterly meeting in April, your executive committee passed the following resolution:—

"*Resolved:* That the American Society for Testing Materials looks with favor upon the proposition of inquiring diligently whether an International Society for Engineering Materials can be formed to take up and broaden the work formerly done by the International Association for Testing Materials.

"Dr. H. M. Howe, past-president of this society, is going to Great Britain and France on a number of missions of a similar general nature, and we should be glad if the appropriate engineering bodies in those and other European countries would discuss with him, as our representative, the propriety of such a step and the means by which it might be brought about.

"We believe that provision should be made for admitting the neutral countries into this organization.

"We believe that the work of such an organization should be broader than was that of the International Association for Testing Materials, and that it should cover the development of knowledge of engineering materials and stimulate the science of testing materials, leading to the erection of international specifications as standards of reasonableness."

9. *International Standards of Testing.*—This is a matter which is of very great importance, and would logically come within the scope of the new international society, if this becomes a reality.

It is to be hoped that through the world war the old "sores" established upon the principle of careful selfishness will have been largely eliminated, and through a League of Nations there shall be established a permanent basis upon which humanity may progress upon modern lines, leaving behind it the old prejudices and really establish a brotherhood of man, which may rest upon a permanent foundation having a realization that the human race is after all but one large family, and that national border lines are but of artificial creation.

Standardization Bodies

The work of standardization in this country has been more or less fragmentary. Such work has been undertaken by individual manufacturers, also by individual consumers, and by associations representing only producers and associations representing only consumers.

A great deal of creditable work has been done by the National Bureau of Standards and some work has been undertaken by the American Institute of Mechanical Engineers, although the constitution of the latter society forbids the adoption of standards. This society, however, accepts its standard committee reports and sets its seal of approval upon the committee's recommendations.

A vast amount of work has been done by the Society of Automotive Engineers in the standardization of automobile parts and recently in aircraft parts. The Master Car Builders' Association and the Master Mechanics' Association have directed their efforts largely to standardization of railroad rolling equipment. The American Railway Engineering Association has devoted its attention primarily to railway subjects. The American Institute of Electrical Engineers and the Electric Power Club have undertaken much standardization work in connection with electrical equipment. Other standardization bodies are at work in various fields.

With the object in view of co-ordinating the standardization work of these various bodies, to foster co-operation between all interested organizations and government departments and to avoid duplication of effort, during the last year the American Engineering Standards Committee was organized. This committee was formed by joint action of five national engineering societies. Our society, being one of that number, therefore became one of the founder societies which organized this committee.

The work of this committee had only about begun when action was taken toward greatly enlarging the size and scope of the committee as originally planned, and proposals were set forth and preliminary action taken to reorganize the committee into an American Engineering Standards Association embracing the subject of safety codes, fire protection, etc.

A considerable amount of discussion has been taking place, questioning if there is any added advantage in having the seal of approval of this committee placed upon the specifications presented to it. It is this function only which the American Engineering Standards Committee contemplated exercising, and this policy will no doubt also prevail if the committee is enlarged and organized as the American Engineering Standards Association. It is quite a serious question as to which is the better method: To grow slowly and conservatively, beginning with an amount of work which can be expected to be handled properly in a reasonable length of time; or to immediately attempt to handle the vast amount which has been more lately contemplated and in so doing incur the danger of at once becoming cumbersome and top-heavy. This is a problem which will remain for the interested societies to pass their judgment upon. Personally and unofficially, I feel that there is a real need and a real field for such a committee or association, and it but remains for the various details as to organization, policy and methods to be worked out and these should have most careful consideration.

Standards Association and Specifications

I feel that the seal of approval of such a committee or association would give great weight and added recognition to a specification. I believe, however, that it would be a decided mistake for such a body to attempt to pass upon the substance of a specification, or to choose between two conflicting specifications covering the same subject which may be presented by two distinct standardizing bodies. No such specification should have the seal of approval unless the specification representing the joint action of such bodies be presented. All such standards, when finally adopted as American standards, should be ever open for revision, otherwise practice will become crystallized.

National engineering bodies are in operation in England, Canada, France and Holland, and it can be confidently predicted that such bodies will be organized in other countries in the near future. Because of our present excellent and rapid means of communication, all the countries of the world are being brought in much closer relationship than ever before and in the immediate future there will begin an era of intermingling of the peoples of the various nations of the earth to a far greater extent than ever before and it is therefore reasonable to assume that before many years have elapsed the needs of the world will demand international standardization to an ever-increasing extent.

The Union of Canadian Municipalities is holding its annual convention this week at Kingston, Ont. Mayor Bouchard, of St. Hyacinthe, Que., is president. H. G. Acres, hydraulic engineer of the Hydro-Electric Power Commission of Ontario, and A. Amos, chief of the Hydraulic Service of Quebec, are on the program for addresses on the undeveloped water-powers of Ontario and Quebec.

Chairman Smithers, of the Grand Trunk Railway, is expected in Ottawa soon to discuss with the government the question of the acquisition of the Grand Trunk by the govment as part of the national railway system. The negotiations in London last summer proved abortive. While the company needs financial assistance, and is prepared to sell out, it is essentially a question of price. The government's offer, which it has not shown a disposition to raise, but which the company has declined to accept, contemplates a 999-year lease, the assumption of liabilities and the guarantee of a rate of interest on the preferred stock equivalent to an average dividend during a term of years when the stock earned dividends. Something would probably be paid also on the common stock.—From "The Toronto Telegram."

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MATHEMATICIANS ENTER INDUSTRIAL FIELD

PROBABLY for the first time in the history of science, professional mathematicians have formally entered the industrial field. Three New York mathematicians have established a consulting office with the object of handling special problems arising in industrial work for the solution of which the knowledge of mathematical specialists can be utilized to advantage.

Each of the members of the firm has been privately engaged for some time in work of this nature in addition to his other professional activities, and they state that "it was at the suggestion of clients that the decision was made to set up a consulting service which would extend to the industrial world the resources of modern, pure and applied mathematics."

"Problems come up in practically all technical fields," they write, "for the satisfactory solution of which the expert application of mathematics is essential. Directors of technical enterprises do not hesitate to call in the consulting engineer, consulting chemist, patent attorney or efficiency expert, but the mathematical features of technical problems are often left without adequate treatment. We are sure that this is due neither to a reluctance of industrial managers to consult mathematicians nor to a lack of desire on the part of mathematicians to handle industrial problems, but rather to the fact that men fitted for consulting service in this field have heretofore been too far removed from the industrial world. It is with the expectation of being of important service to the technical public, that we announce the establishment of our office."

The new firm will be known as Dantzig, Pfeiffer & Ritt, with offices at 500 West 116th Street, New York City. Dr. T. Dantzig is a graduate of the University of Paris. He has taught at Indiana and Columbia Universities, and during the war was in charge of the mathematical work of the instrument section of the U. S. Ordnance Department. Dr. G. A. Pfeiffer is a graduate of the Stevens Institute of Technology. He has taught mathematics at Harvard, Princeton and Columbia Universities, and is associate editor of the Annals of Mathematics. Dr. J. F. Ritt is a graduate of Columbia University. For three years he was in the Naval Observatory and has since taught mathematics at Columbia. During the war he was one of the chief ballisticians in the U. S. Ordnance Department.

Among the industrial applications of pure mathematics in which the firm claim that their services will be useful, are the following:—

Problems in statistics and probability; design of measuring and computing apparatus; design of optical instruments; mathematical treatment of problems in mechanism; mathematical formulation for patent claims of principles underlying inventions; scientific development of inventions; problems in aeronautics; and preparation of graphs, diagrams and charts.

WINNIPEG RIVER POWER CO., LTD.

ACTIVE work has begun on the construction of the new hydro-electric plant for the Winnipeg River Power Co., Ltd., on the Winnipeg River, 14 miles north of Lac du Bonnett, Man. The design contemplates the ultimate installation of six units of 28,000 h.p. each. The initial installation will be two units. The plant is being built by the Northern Construction Co., Ltd., for the power company, which is a subsidiary of the Winnipeg Electric Railway Co.

Before the war it became evident that the railway company would soon require a large quantity of power, but after plans had been prepared and a standard-gauge railway built from Lac du Bonnett, on the Canadian Pacific Railway, to the power site, it was found that the finances of the company did not permit a continuance of the enterprise.

After the armistice the project was revived, but the war had played havoc with the finances of the railway company and it was unable to assist further in the financing. The late A. C. Mackenzie, who was then president of the Northern Construction Co., entered into an agreement with the power company that his concern would build the dam and finance the cost of the undertaking until such time as the power company's bonds could be sold. No money will be due the construction company until the fall of 1920, by which time it is expected that the bonds will be marketed.

The main dam will be over 2,000 ft. long and 70 ft. high, and will be built of reinforced concrete; the power house will be of steel and brick, 450 ft. long by 140 ft. wide and over 100 ft. high.

The power from the new plant will be transmitted to Winnipeg over a 70-mile line with steel towers. A 65 ft. by 255 ft. steel-and-brick transformer station will be built at Winnipeg. Another line will connect the new plant with the present transmission line from Pinawa to Winnipeg at a point of about five miles south of Lac du Bonnett. The new plant will thus be connected with the city by two separate lines located at a considerable distance from each other.

F. A. Martin, who was formerly in private practice at Niagara Falls, N.Y., is in charge of the design of the plant. He has established an office in Winnipeg. R. S. & W. S. Lea, of Montreal, are the consulting hydraulic engineers, and Louis J. Hirt, of the Pearson Engineering Corporation, New York, has also been retained in an advisory capacity.

PORT COLBORNE ELEVATOR INVESTIGATION

FOLLOWING are the members of the board that has been appointed by the Dominion government to investigate the dust explosion in the government-owned grain elevator at Port Colborne, Ont., which last week killed ten workmen and badly wrecked the $2,000,000 structure:—Lieut.-Col. C. N. Monsarrat, consulting engineer to the Department of Railways and Canals; A. St. Laurent, assistant deputy

minister of the Department of Public Works; D. W. McLachlan, engineer in charge of the Port Nelson terminals of the Hudson Bay Railway; John Murphy, electrical engineer of the Department of Railways and Canals. The board is given full power to call witnesses. It is to have charge of salvaging the grain and is to make recommendations as to reconstruction.

PERSONALS

JOHN MURPHY, of Ottawa, Ont., who recently announced that he had obtained excellent moving pictures showing the formation of frazil and anchor ice, is the electrical engineer of the Department of Railways and Canals and of the Board of Railway Commissioners for Canada. Mr. Murphy was born December 17th, 1868, in Ottawa. In 1884 he graduated from the College (now University) of Ottawa, and joined the staff of the Bell Telephone Co. From 1884 he was also connected with Ahearn & Soper, who, a short time previously, had formed an electrical supply and agency house. As Mr. Ahearn was also the Ottawa manager of the Bell Telephone Co., and Mr. Soper the superintendent of the Canada Mutual Telegraph Co., Mr. Murphy came into intimate contact with the work of these two concerns. During the latter part of 1885 and the following year, Mr. Murphy was in charge of Gilmour & Co.'s arc light plant at their Gatineau mills at the falls near Chelsea, Que., incidentally acting as assistant to the general superintendent during the construction of new mills and workshops. In the spring of 1887, Ahearn & Soper formed the Chaudiere Light, Heat & Power Co., engaging Mr. Murphy to assist in the installation of the lighting system and to take subsequent charge of its operation. This company at first rented water power but soon built its own hydraulic and steam plants. Mr. Murphy was power superintendent, and practically the whole engineering staff under Mr. Ahearn, who acted as president and chief engineer. In 1894 the Chaudiere Co. and two other concerns were amalgamated as the Ottawa Electric Co., bringing five water power plants and one steam plant under its management, and Mr. Murphy was appointed Superintendent of Power Houses, retaining that title until 1906, when he was appointed to his present position with the Department of Railways and Canals and the Railway Commission. In 1891 the Ottawa Electric Railway began operation, having also been organized by Ahearn & Soper. Mr. Murphy acted as consulting engineer to this enterprise from its inception until 1906. From time to time he also acted as consulting engineer to a number of other enterprises, including, in 1902, the Montreal Locomotive Works at Longue Point, and in 1910, the Dominion Iron & Steel Co. and the Dominion Coal Co. During the last year of the war, the Fuel Controller of Canada appointed Mr. Murphy as his special agent to prevent coal consumption for the production of power at points where hydro-electric power was available. Many thousand tons of coal were saved as a result of Mr. Murphy's efforts at a time when coal was the most important of all products to a very great many Canadians. Ever since his appointment by the Federal Government, Mr. Murphy has been acting as consultant for almost every department of the government in which hydraulic or electrical problems have arisen. He is a member of the Dominion Power Board, and has been a member of the Canadian section of the International Electro-Technical Committee since its formation. He is also a fellow of the American Institute of Electrical Engineers and a councillor of the Engineering Institute of Canada. In 1915 and 1916, Mr. Murphy was chairman of the Engineering Institute's Ottawa branch. At the Institute's last annual meeting, he read a paper on railroad electrification, and also discussed, in a most interesting manner, hydro-electric ice troubles.

CAPT. J. P. CORLEY, of New York, has arrived in Canada for the purpose of taking charge of the pump department of the Canadian Ingersoll-Rand Co., Ltd. His headquarters will be at the company's Toronto office.

LT.-COL. H. R. LORDLY, formerly construction engineer, Lachine Canal, has returned to Montreal from France, and will open an office as consulting engineer. Col. Lordly took the 5th Pioneer Battalion overseas in 1916.

N. S. BRADEN, sales manager of the Canadian Westinghouse Co., Ltd., of Hamilton, has been elected vice-president of the company. H. M. BOSTWICK, assistant sales manager, has been appointed sales manager to fill the vacancy created by Mr. Braden's promotion.

GEO. K. MCDOUGALL, consulting engineer, Montreal announces that he has taken Major E. Raymond Pease, D.S.O., into partnership. The name of the new firm will be McDougall & Pease. They will specialize in industrial applications of electricity, illuminating engineering, electric power stations and high voltage power transmission.

MAJOR N. M. HALL, O.B.E., has arrived home from overseas. Major Hall graduated from McGill University in 1907, in mechanical engineering. Going to Vancouver, he became associated with the firm of Ducane, Dutcher and Co., consulting engineers. In 1915 he enlisted with the Royal Engineers as a lieutenant. He went to France in December, 1915, and won his majority on the field.

ROBT. H. PARSONS, who, previous to the war, was in charge of the water works of the city of Edmonton, is now in Canada in the interests of John Birch & Co., Ltd., London, Eng., with whom he has accepted a position as sales engineer. Mr. Parsons will make his headquarters in London. During the war he was with the Royal Engineers at first, and later, with the Ministry of Munitions.

M. U. FERGUSON, city engineer of St. Thomas, Ont., has resigned, owing to alleged interference with his department by the chairman of the Board of Works. Mr. Ferguson is planning to enter the contracting field. He has been city engineer of St. Thomas for over six years, and for several years previously was city engineer of Stratford, Ont. Before going to Stratford, he was engineer on the location and construction of a number of railway lines.

H. E. M. KENSIT, who joined the C.E.F. in September, 1915, has returned to the Dominion Water Power Branch, Ottawa. He was attached to the Canadian Engineers for two years, and after being wounded at Vimy Ridge was transferred to the Ministry of Munitions, England, for a further seventeen month. Since the armistice he has represented the Dominion Water Power Branch as a member of the water power committees now sitting in England, including that of the Conjoint Board of Scientific Societies on water powers of the Empire, and that of the Board of Trade, formed at the request of the Ministry of Reconstruction, on the water-power resources of the United Kingdom.

OBITUARY

GEO. H. BAIRD, chief draftsman of the Public Works Department, Province of Manitoba, died last month suddenly at his residence in Winnipeg.

WORLD IS ON HIGHER PRICE LEVEL

(Continued from page 220)

materials are more likely to be somewhat higher on the average in 1920, than at present, rather than lower.

Not only is the demand for houses imperative and the cost of construction cheap in proportion to prices of commodities in general, but there is every prospect that the return to those who invest in building now will adequately cover present construction costs.

Rents and Property Value

Rents and property values have, naturally, been slow in adjusting themselves to the new price level. It was reported at the beginning of the year that in 52 cities rents on the average have increased 105 per cent. In some cities they had increased 40 per cent. to 50 per cent. That was merely the beginning. Rents have advanced everywhere since January, and real estate valuations have advanced in proportion to the advances in rent.

Placing cots in churches is only a temporary measure of relief. Appointing committees to investigate rent profiteering may ameliorate the inconveniences of the adjustment to new rent levels. Perhaps some people have profited by the situation who have little claim in justice to the profits. Adjustments to new economic conditions are not always accomplished easily. The only practical solution of the problem of the shortage of housing facilities is the building of houses. The ultimate solution of the problem of high rents is the resumption of all business activities to the extent that the tenants can earn enough money to pay the rents.

There is little likelihood that the building of new houses will cause rents to decline, for the rents on the new houses will have to be adjusted so as to give an adequate return on the amount invested in the new buildings.

H. P. Eddy, of Boston, Mass., who is consulting engineer to the sewerage commission of Milwaukee, Wis., was in the latter city recently in order to test the Jones Island sewage disposal plant. He states that the experiments conducted have demonstrated the efficacy of the activated sludge system of treating sewage, as worked out under T. C. Hatton, chief engineer of the commission. Mr. Eddy was a member of the original commission which investigated the sewage question in Milwaukee ten years ago, whose report resulted in the decision to build a disposal system. Since then Mr. Eddy has been retained as consulting engineer. He is quoted by the Milwaukee newspapers as saying: "My visit here was to study the results of experiments made since April 1 in the pressing and drying of sludge to make it suitable for sale as a fertilizer base, also to examine the results of the operation of a demonstration plant since the fall of 1918. All these experiments have been made most carefully and carried out to my entire satisfaction. I am convinced that the investigations made at the Jones Island plant have been of great value in solving the problem under consideration. The results of the experiments and the operation of a portion of the plant demonstrated, in my opinion, the entire practicability of the process, that sewage disposal by the activated sludge process is practical, and that an effluent of the standard adopted by the sewerage commission can be produced. While there are some details of design which remain to be worked out, the results of the demonstration conducted during the past year indicate that the general plan proposed by T. C. Hatton in August, 1917, is the plan for the treatment of sewage by the activated sludge method which is best adapted to local conditions. The activated sludge process of sewage treatment as developed by the experiments at Jones Island will purify sewage as well or better than any other method of sewage treatment at present known or in use. Sewage treated by this process will be in a satisfactory condition for discharge into the lake. The solids produced from the activated sludge process as suggested for the Milwaukee plant, can be reduced to a fertilizer base from the sale of which the city will receive substantial returns."

HOW TO REDUCE RISKS IN EARTHWORK

(Continued from page 224)

gang. This is often not so easy of accomplishment as it sounds. Usually, the only practical way of estimating the daily yardage is by counting the loads; but loads may vary considerably in size, and it may not be easy to keep tabs on the number of loads.

Carloads and wagonloads vary because of differences in the kind of earth, differences in the resistance to traction, difference in attention given to the loading, etc. Study every cause of variation in size of loads with a view to learning how to estimate the "place measure" size of a load under given conditions.

Estimate Yardage Accurately

Your own estimates of yardage, based on the count of loads, should be compared with monthly cross-section estimates made by engineers. Do not think the engineer is necessarily wrong because his monthly estimate is far below your estimate. Perhaps your "tally" is wrong. More probably you have estimated too liberally as to the size of the average load. Buy two mechanical counters or "tally machines" for use at the pit and dump.

My brother, W. A. Gillete, has devised a satisfactory method of estimating the daily yardage handled by drags, fresnos and wheelers. A timekeeper on horseback rides from gang to gang, spending about 20 min. at each gang, during which time he counts the number of scraper loads moved by the gang. Three or more such counts are made every day for each gang, and upon these counts is based an estimate of the yardage excavated each day by every gang. The accuracy of this intermittent timing method of estimating yardage is astonishing. The engineers' monthly estimate seldom differs more than 5% from the estimate thus made by the timekeeper. The great merit of such daily estimates of yardage consists in showing at once the relative efficiency of different methods, machines and men.

Compare Labor With Machines

I have mentioned the unreliability of most common laborers on grading work. This unreliability, coupled with the high wages now paid to common laborers, is leading to a greater use of machinery than ever before, even on small jobs. In China, with wages at 15 cents a day, machinery could seldom compete with hand work, for the interest, repairs and depreciation on the plant alone exceeded the cost of doing the work by hand in most cases. That is one extreme. At the other extreme we now have American unskilled labor getting 30 to 60 cents an hour, the average being about 40 cents. Skilled labor has risen about 60% in price as compared with a rise of about 100% for unskilled labor. Machinery has not risen in price as much as skilled labor, and excavating machinery grows better every year. Hence it is that nearly all of us must revise our pre-war ideas about the use of machinery.

High wages lead inevitably to a greater use of machinery. This has long been evident on the Pacific Coast, where contractors found it profitable, long before the war, to use more machinery than was customary in the Central, Southern and Eastern States. Wages on the Pacific Coast averaged about $2.50 a day for common labor prior to the war, whereas about $1.75 was the average in the East. That difference alone justified the greater use of machinery in the far West. Is it not clear, then, that with common labor wages double what they were five years ago, there must be a greatly increased use of machinery in construction work?

Hereafter the slogan of the far-sighted contractor will be: More power and less muscle; fewer men and greater hustle.

J. A. Ellis, Director of Municipal Affairs of Ontario, estimates that 1,500 houses will be built this year under the provisions of the Ontario Housing Act. A far greater number will be built next year, he states.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand or proposed, contracts awarded, changes in staffs, etc.

ADDITIONAL TENDERS PENDING

Further information may be had from the issues of *The Canadian Engineer*, to which reference is made.

PLACE OF WORK	TENDERS CLOSE	ISSUE OF	PAGE
Bridgeville, N.S., school	Aug. 30.	July 31.	41
Cornwall, Ont., rebuilding north pier	Aug. 19.	Aug. 7.	50
Halifax, N.S., schools	Aug. 30.	July 31.	41
North Lake, P.E.I., boat harbor.	Aug. 19.	Aug. 7.	50
Ottawa, Ont., pumps, engines, etc.	Aug. 30.	July 31.	44
Peterborough, Ont., public school	Sept. 1.	Aug. 7.	48
Pickering, Ont., abutments, roadways and sidewalks for bridge	Aug. 19.	Aug. 7.	45
Saskatoon, Sask., tubo-generator	Sept. 23.	July 24.	44
Toronto, Ont., grading and road construction	Aug. 18.	July 31.	40
Toronto, Ont., highway structures	Aug. 19.	July 31.	46
Toronto, Ont., bank building.	Aug. 19.	Aug. 7.	48
Toronto, Ont., additions to school	Aug. 27.	Aug. 7.	48
Toronto, Ont., cantilever crane.	Aug. 19.	Aug. 7.	50
Toronto, Ont., 24-in. castings.	Aug. 19.	Aug. 7.	50
Winnipeg, Man., water recorder	Sept. 1.	July. 31	46

BRIDGES, ROADS AND STREETS

Amherst, N.S.—Tenders will be received until 12 o'clock noon, August 15th, by the department of public works, Ottawa, for grading, construction of pavement, sidewalks, etc., for waterproofing basement walls and for mastic floor, drill hall, Amherst, N.S. Plans, etc., at office of chief architect, Ottawa; caretaker, public building, Amherst, N.S.; superintendent public buildings, St. John, N.B.; inspector Dominion buildings, Halifax, N.S. R. C. Desrochers, secretary.

Belleville, Ont.—Tenders will be received until 5 p.m., August 15th, by the city council, for construction of approximately 25,000 sq. yds. asphaltic concrete pavement, curb, gutter and storm sewers. J. G. Mill, city engineer.

Halifax, N.S.—Contract has been awarded by the Relief Commission for construction of over a mile of streets, 80 ft. in width, to the Bedford Construction Co. Contract price, approximately $30,000.

Quebec, Que.—Plans are being prepared by the department of public works for a new batiscan bridge for the Quebec-Montreal highway. Tenders will probably be called on completion of plans.

Regina, Sask.—Contract has been awarded by the city council, for construction of street pavement and spur track pavement, to the Crown Paving and Construction Co., Calgary, Edmonton and Regina. D. A. R. McCannel, city engineer.

Regina, Sask.—Tenders will be received until noon, August 18th, by the department of public works, Ottawa, for construction of pavement in lane adjoining post office building. Plans, etc., at offices of chief architect, Ottawa; clerk of works, Regina; resident architect, 802 Lindsay Building, Winnipeg, Man. R. C. Desrochers, secretary.

Saskatoon, Sask.—Contract recently awarded by city council for paving Saskatchewan Crescent to Bitulithic Co., Winnipeg. Contract price, $27,000.

Ste. Martine Municipality, Chateauguay, Que.—Tenders will be received until 7 p.m., August 30th, by the municipal council for construction of about 5 mls. of bituminous macadam road, including bridges. Nap. Mallette, secretary-treasurer.

Three Rivers, Que.—Contract has been awarded by the department of public works, for sidewalks and grading for public building, to A. Héon & Co., Three Rivers. Contract price, $13,808. R. C. Desrochers, secretary.

Toronto, Ont.—The city council has decided to widen Bloor St. west of Quebec Ave., to 86 feet. R. C Harris, commissioner of works.

Vancouver, B.C.—A deputation from the Vancouver Automobile Club will request the provincial government to extend the road construction program, which was announced to be about three miles in length between New Westminster and the international boundary, to include the entire distance. R. H. Gale, mayor.

Webbwood, Ont.—Tenders will be received until August 23rd by the town council for construction of 1,000 lin. ft. of 6-ft. concrete walks. J. C. McMillan, clerk.

Windsor, Ont.—The ratepayers have voted against the proposed by-law for construction of sidewalks aggregating 28.27 mls. in length and to cost $100,000.

York Township, Ont.—Contracts have been awarded, by the township council, for construction of sidewalks as follows: on Hillbrow Ave., to Walton & Rowell, $1,720.00. Rejected tenders from A. Johnson, $3,250.00; Frank Angotti, $3,225.00; W. Hughes, $2,902.00; National Construction Co., $3,498.00. Westwood Ave., to Walton & Rowell, $1,297.00. Rejected tenders from A. Johnson, $2,520.00; Frank Angotti, $2,700.00; W. Hughes, $2,150.00; National Construction Co., $2,388.00. Frank Barber, engineer.

York Township, Ont.—The township council proposes to construct the following pavements: 24 ft. Tarvia X on Glenholme Ave., Medway Ave. to Rogers Rd.; cost, $2,000. Westmount Ave., from north end of pavement to Miller Ave.; cost, $3,300. Concrete sidewalks on Bernice Cres., N. side, 4 ft. 6 in., with curb; cost, $4,600. Dennis Ave., N. side, 5 ft. 6 in., with curb, from Weston Rd. to Syndicate Ave.; cost, $1,800. Gamble Ave., S. side, 4 ft. 6 in., from Don Mills Rd., to Leslie St.; cost, $4,700. McRoberts Ave., both sides, 4 ft. 6 in., with curb, from north city limits to Summit Ave.; cost, $8,500. Poulton Ave., N. side, 4 ft. 6 in., with curb, Woodbine Ave., westerly 1,940 ft.; cost, $4,500. Torrens Ave., N. side, 4 ft., with curb, from Don Mills Rd. to Pape Ave., and a 4 ft. without curb, N. side, from Pape Ave. to Leslie St.; cost, $5,500.

WATER, SEWAGE AND REFUSE

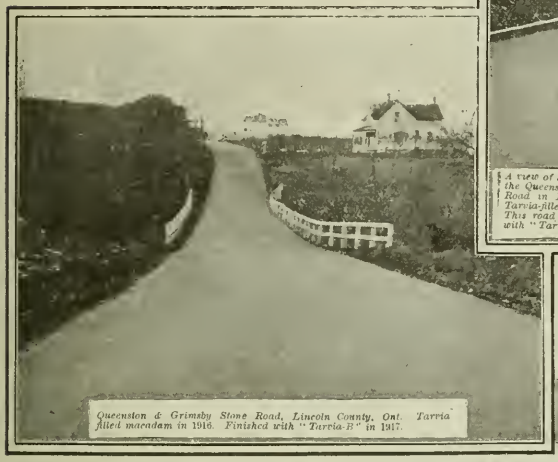
Birchcliffe, Ont.—A public meeting will be held on September 15th to discuss plans drawn for a new waterworks system for part of Scarboro' township. E. A. James, engineer. Estimated cost, $100,000.

Dalhousie, N.B.—Tenders will be received by the town council until 8 p.m., August 15th, for excavation and grad-

Tarvia

Preserves Roads
Prevents Dust~

A view of Jordan Hill section of the Queenston & Grimsby Stone Road in Lincoln County, Ont. Tarvia-filled macadam in 1916. This road was treated in 1917 with "Tarvia-B."



Queenston & Grimsby Stone Road, Lincoln County, Ont. Tarvia filled macadam in 1916. Finished with "Tarvia-B" in 1917.

Auto-Tank Sprayer distributing Tarvia

County of Lincoln (Ont.) adopts Tarvia for all main highways—

The following letter from Mr. Lewis H. Collard tells the story of the experience of the County of Lincoln, Ont., with Tarvia roads. It proves again that Tarvia solves the good road problem satisfactorily and economically, and that Tarvia highways will stand up under the heaviest kind of traffic.

Mr. Collard writes :

"I feel that if I did not give you an unsolicited testimonial of my experience with your Tarvia products, I would not be doing my duty to my fellow municipal officers in the Dominion of Canada, who may have under their consideration the building of some more permanent highways than the old water-bound macadam type.

The County of Lincoln two years ago built about two miles of Tarvia road on its main highway from the village of Jordan, running west, better known as the Queenston & Grimsby stone road, a road which carries the traffic from Canada to the Niagra Frontier and from the United States to Hamilton, Toronto, and farther east, and therefore is one of the heaviest travelled roads in the Province of Ontario, both in tourist and local traffic, having as high as one thousand automobiles and trucks passing over it in a day, and I can only say, after two years of this kind of traffic, the road is in first class condition to-day, and has pleased the County of Lincoln so much that they intend to build their main highways in the County Road system of the same type."

(Signed) LEWIS H. COLLARD,
Chairman, Lincoln County Roads

Nothing more need be said, except to remind you again that no matter what your road problem may be—whether you require a road binder, a dust preventive, a road preserver, or a patching material—there is a grade of Tarvia for the purpose.

Write for further information and illustrated booklets

The Barrett Company
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MONTREAL TORONTO WINNIPEG ST. JOHN, N.B. HALIFAX, N.S. SYDNEY, N.S. VANCOUVER

ing of all earth and rock, supply of material and construction of water-works reservoir. F. W. Holt, engineer, 55 Canterbury St., St. John, N.B. J .E. Stewart, town clerk, Dalhousie.

North Bay, Ont.—Contract has been awarded by the town council for construction of sewers on Cassels, McIntyre, Bloem and Worthington Sts. to Angelo Chinco, North Bay, Ont. H. J. McAuslan, town engineer.

Winnipeg, Man.—Contract has been awarded by the city council, for construction of water mains on Centennial, Lindsay, Sandhurst and Sylvia St., to Dominion Construction Co., 676 Main St., Winnipeg. C. J. Brown, city clerk.

Woodstock, Ont.—The provincial board of health, Ontario, has notified the city council that they will not approve of the plans submitted to them of the new sewerage system until the complete details, showing method of disposal of the sewage is included. It is probable that the activated sludge process will be installed. Additional cost, $10,000.

York Township, Ont.—Contracts have been awarded by the township council for construction of water mains as follows; to Murphy Construction Co., Bernice St., $3,830.70, Florence St., $2,301.50, Thornhill St., $3,882.45; to McNamara Bros. & Co., Sault Ste. Marie, Hanson St., $2,220.35, Atlas St. N., $958.95, Robina St., $3,713.60, Tay St., $2,665.35; to Angelo Cavoti, Miller St., $1,587.75. Rejected tenders from Murphy Construction Co., Hanson St., $4,878.50, Miller St., $2,009.50, Atlas St. N., $2,074.50, Robina St., $6,370.00, Tay St., $5,275.00; McNamara Bros. & Co., Bernice St., $5,823.80, Miller St., $1,603.60, Florence St., $3,436.70, Thornhill St., $5,710.20; J. H. McNight Construction Co., Bernice St., $4,806.50, Atlas St., N., $1,264.55, Tay St., $3,837.00, Florence St., $2,764.50, Thornhill St., $5,532.50; Angelo Cavoti, Bernice St., $4,455.10, Hanson St., $2,473.00, Florence St., $2,536.50, Thornhill St., $4,444.40. Frank Barber, engineer.

York Township, Ont.—The township council proposes construction of 6-in. cast-iron water mains and appurtenances on the following streets: Waterworks Section A—Amherst Ave., from Oakwood Ave. westerly to Lauder Ave., 1,172 ft.; Jesmond Ave., from Oakwood Ave. westerly to Glenholme, 810 ft.; Ashbury Ave., from Oakwood Ave. to west end, 680 ft.; Roach Ave., from High St. northerly to Vaughan Rd., 1,236 ft.; Humewood Ave., from High St. northerly to Vaughan Rd., 1,316 ft. Estimated cost, $20,000. Craydon Ave., from Weston Rd. to railway tracks, 900 ft.; Ray Ave., from Weston Rd. to railway tracks, 450 ft:; Rutherford Ave., from Weston Rd. to railway tracks, 875 ft.; Victoria Blvd., from Weston Rd. to railway tracks, 760 ft.; Eglinton Ave., from Weston Rd. to railway tracks, 533 ft.; Brownhill Ave., from Eglinton Ave. to south end, 926 ft.; Barr Ave., from Brownhill Ave. to Weston Rd., 216 ft.; Elora Ave., from Bartonville Ave. to Jane St., 406 ft. Estimated cost, $20,000. Cliff St., Bushey Ave. and Jasper Ave., from Lambton Ave. to Langdon Ave., 1,485 ft.; Jasper Ave., from Cliff St. to west end, 124 ft.; Langdon Ave., from east end to west end, 316 ft.; Orla Ave., from Lambton Ave. southerly 550 ft.; Chryessa Ave., from Lambton Ave. southerly 1,134 ft.; Gray Ave., from Lambton Ave. southerly 758 ft.; Outlook Ave., from Beechwood Ave. to Chryessa, 192 ft.; Humber Crest Blvd., from Weston Rd. to west end, 1,580 ft. Estimated cost, $14,000. Lauder Ave., from Rogers Rd. to Vaughan Rd., 3,200 ft. Estimated cost, $12,800. Mitchell Ave., from Eglinton Ave. to Jackes Ave., 1,136 ft. Estimated cost, $4,500. Northland Ave., from Weston Rd. to Spears St., 1,974 ft.; Lapp St., from Northland Ave. to McCormack St., 814 ft.; Spears St., from Northland Ave. to north end, 344 ft.; McCormack St., from city limits to 671 ft. west, 671 ft. Estimated cost, $15,000. Northcliffe Blvd., from Vaughan Rd. north to Eglinton Ave., 493 ft. Estimated cost, $1,970. Waterworks Section B—Morningside Ave., from Kennedy St. to Windermere Ave., 1,500 ft.; Lavinia Ave., from Morningside Ave. to Park Rd., 1,093 ft.; Runnymede Rd., south from Park Rd. to Morningside Ave., 1,046 ft.; Lavinia Ave., south from Morningside Ave. to the south limit of lot 18, plan M82, 259 ft.; Ostend Ave., west from Windermere Ave. to Willard Ave., 315 ft. Estimated cost, $16,650. W. A. Clarke, clerk.

LIGHT, HEAT AND POWER

Calgary, Alta.—The Hudson's Bay Co. have signed contract to purchase electrical power from the city. In agreement, is a provision by which the company agrees to operate its own plant during peak load shortage in the months of December and January, if requested so to do by the city.

Kapuskasing, Ont.—The Spruce Falls Pulp & Paper Co. will shortly commence construction of their new plant. It is said that the power will be obtained from rapids, ten miles up the river. S. A. Munday, Bradford, Pa., president.

Minnedosa, Man.—The town council has requested permission from the Public Utilities Commission, to acquire the plant of the Minnedosa Power Co., should the company fail to fulfil its obligation to supply the town with the necessary amount of light and power.

Niagara Falls, Ont.—The city council has made an agreement with the Hydro-Electric Power Commission for supply of power to Chippewa, Ont.

RAILWAYS

Brantford, Ont.—The Lake Erie and Northern Ry. have made surveys and will construct a switch line into the Holmdale district.

Fredericton, N.B.—The International Railway has been purchased by the Dominion government, and will probably be run as part of the C.N. Ry. system. H. A. Carr, K.C., Campbellton, N.B.

Galt, Ont.—The Grand River Ry. will remove their tracks from Water St. and enter the city over a private right-of-way, upon the expiration of their franchise in February, 1921. J. McCartney, city clerk.

Guelph, Ont.—The ratepayers have voted against the proposed Grand River Valley Railway agreement by which the municipal street railway was to be operated by the Valley railroad and connections established with Hespeler, Galt, Hamilton and other cities. The Hydro-Electric Power Commission opposed the by-law, Sir Adam Beck stating that the "hydro radials" would cover this field, and that the proposed agreement would interfere with the Commission's plans.

Kitchener, Ont.—The city council are contemplating purchase of the Waterloo and Wellington Railway. Estimated sale price to the city, $75,000 V. S. McIntyre, superintendent of the street railway commission, is investigating the financial side of the company.

Long Branch, Ont.—A deputation of ratepayers contemplate requesting Sir Adam Beck to take over the York radial lake shore division and operate it as a public utility.

Port Alberni, B.C.—Tenders may soon be called by the E. & N. Railway for construction of 12 miles of railway on Vancouver Island, extending the line from Port Alberni into the Great Central Lake district. R. Marpole, general executive, C.P. Ry., and president of the E. & N. Ry.

Sherbrook, Que.—The Sherbrooke Railway and Power Co. contemplates extensions to the street railway system.

Toronto, Ont.—The city council has decided to double-track west Bloor St., from Quebec Ave. to Runnymede Rd. Estimated cost, $160,000. R. C. Harris, commissioner of works.

FACTORIES AND LARGE BUILDINGS

Alderson, Alta.—Tenders will be received until noon, August 21st, by the board of trustees, Daisy Dell school district, No. 2685, for construction of a frame school building. F. Goehring, secretary-treasurer.

Bassano, Alta.—Tenders will be received until noon, August 16th, by the department of railways and telephones, Edmonton, Alta., for construction of a telephone exchange building. N. L. Harvey, deputy minister.

BURLINGTON

STEEL BARS FOR CONCRETE REINFORCING

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SECTIONS

PROMPT
SHIPMENT

Brantford, Ont.—The Brantford Piano Case Co. contemplate further extensions to their plant.

Calgary, Alta.—The Bruner block on First St. West will be reconstructed as a high-class hotel. Estimated cost, $50,000. R. S. Noble, Calgary.

Castor, Alta.—Tenders will be received until noon, August 16th, by the department of railways and telephones, Edmonton, Alta., for construction of a telephone exchange building. N. L. Harvey, deputy minister.

Charlottetown, P.E.I.—Contract has been awarded, to H. and S. Lowe, for construction of an addition to St. Paul's Church. J. E. Harris, architect.

Chatham, Ont.—A new three-story brick factory building will be erected immediately by the Gray-Dort Motor Sales Co. Daniels & Vickery, Chatham.

Claresholm, Alta.—Tenders will be received until noon, August 16th, by the department of railways and telephones, Edmonton, Alta., for construction of telephone exchange building. N. L. Harvey, deputy minister.

Didsbury, Alta.—Tenders will be received until noon, August 16th, by the department of railways and telephones, Edmonton, Alta., for construction of a telephone exchange building. N. L. Harvey, deputy minister.

Edmonton, Alta.—Tenders will soon be called, by the city council and the board of the Royal Alexandra Hospital, for construction of a new wing to the main building. Estimated cost, $225,000.

Edmundston, N.B.—Tenders will be received until 12 o'clock noon, August 16th, by the chief engineer, C.N. Ry., Moncton, N.B., for construction of a car shop. C. B. Brown, chief engineer. F. P. Brady, general manager, Moncton, N.B.

Fort William, Ont.—The Kakabeka Falls Brewing Co. are extending their present buildings to accommodate an additional bottling plant.

Halifax, N.S.—Tenders will be received until noon, August 23rd, by the C.N. Ry., for construction of Transit sheds Nos. 21 and 22. Plans, etc., at the offices of resident engineer, C.N. Ry., Tunnel Sta., Montreal; chief engineer, Moncton, N.B., and the superintending engineer, 137 Barrington St., Halifax, N.S. C. B. Brown, chief engineer, Moncton, N.B.

Ingersoll, Ont.—The board of education has requested the city council to prepare a by-law for construction of a new central school. Estimated cost, $120,000. Mayor Buchanan.

Kitchener, Ont.—Contract has been awarded, by A. & C. Boehmer Box Co., for erection of addition to factory to Steve Becker. Contract price, approximately $10,000. W. C. Cowan, architect.

Kitchener, Ont.—Plans have been submitted for extension to the House of Refuge. Charles Knechtel, architect. D. Cross, mayor. Estimated cost, $88,000.

Lougheed, Alta.—Tenders will be received until noon, August 16th, by the department of railways and telephones, Edmonton, Alta., for construction of telephone exchange building. N. L. Harvey, deputy minister.

Montreal, Que.—The Montreal Amusement Co. will shortly begin construction of a new arena and skating rink building in Montreal to be completed before December 25th.

Oshawa, Ont.—Tenders will be received until noon, August 22nd, by the department of public works, Ottawa, for construction of an examining warehouse. Plans, etc., at offices of chief architect, Ottawa; superintendent of Dominion buildings, postal station "F," Toronto, and caretaker, public building, Oshawa. R. C. Desrochers, secretary.

Parkside, Sask.—Tenders will be received until 5 p.m., August 22nd, by the board of school district, No. 1445, for erection of a brick school building. W. E. Kimber, secretary-treasurer.

Port Arthur, Ont.—Tenders will be received until August 16th by the department of public works, Ontario, for construction of a dwelling-house at Port Arthur Fish Hatchery. Plans at the office of H. A. McKibbon, Whalen building, Port Arthur, Ont. H. F. McNaughten, secretary, Toronto.

Regina, Sask—Contracts have been awarded by the provincial government, for construction of the government office building on Cornwall St., to the Poole Construction Co., contract price, $149,962. Rejected tenders, Parsons Construction Co., $179,600; Minkley & Jones, $175,000; Smith Bros. & Wilson, $167,000; McKay Construction Co., $164,800; Wilson & Wilson, $158,800; Carter, Halls, Aldinger Co., $150,229. Plumbing and heating contract awarded to Regina Plumbing & Heating Co., $14,532. Rejected tenders, Yost Bros., $15,725; Whiteford Bros., $14,790.

Saskatoon, Alta.—The Interprovincial Flour Mills will erect an addition to warehouse. Estimated cost, $10,000.

Sydney, N.S.—Tenders will be received until August 25th for construction of a church at Dominion No. 4, Cape Breton. Plans, etc., may be seen at Glebe House. J. J. Macneil, P.P.

Sydney, N.S.—Tenders will be received until 12 o'clock noon, August 16th, by the chief engineer, C.N. Ry., Moncton, N.B., for construction of stores building. C. B. Brown, chief engineer. F. P. Brady, general manager, Moncton, N.B.

Toronto, Ont.—Tenders will be received until 4 p.m., August 27th, by the board of education, 155 College St., for addition to Keele St. school. Architects, Chapman & Oxley, Harbor Commission Building, Toronto. W. C. Wilkinson, secretary-treasurer.

Toronto, Ont.—Tenders will be received until 4 p.m., August 27th, by the board of education, 155 College St., for addition to Earl Grey school on Jones Ave. W. C. Wilkinson, secretary-treasurer.

Toronto, Ont.—Tenders will be received until 4 p.m., August 27th, by the board of education, 155 College St., for addition to the Duke of Connaught School, Morley Ave. W. C. Wilkinson, secretary-treasurer.

Toronto, Ont.—Tenders will be received until 4 p.m., August 18th, by the board of education, 155 College St., for local telphones and electric wiring at various schools, plumbing at Park, Dufferin and Winchester schools, concrete work at Queen Alexandra, masonry work at Brock Ave., electric motors at Roden and Ryerson, and local ventilation at York St school. W. C. Wilkinson, secretary-treasurer.

Toronto, Ont.—The King Edward Hotel Co. contemplate construction of a 15-story addition to the present hotel on King St. East. The new annex will contain 500 rooms, banquet hall to seat 1,000, convention hall to seat 2,000, and a roof garden. Construction will probably start in November and be completed within 12 months. Approximate cost, $2,000,000. G. H. O'Neil, manager.

Toronto, Ont.—The William Davies Co. will soon commence construction of their new building, 31 Queen St. West.

Viking, Alta.—Tenders will be received until noon, August 16th, by the department of railways and telephones, Edmonton, Alta., for construction of telephone exchange building. N. L. Harvey, deputy minister.

Wainwright, Alta.—Tenders will be received until noon, August 16th, by the department of railways and telephones, Edmonton, Alta., for construction of telephone exchange building. N. L. Harvey, deputy minister.

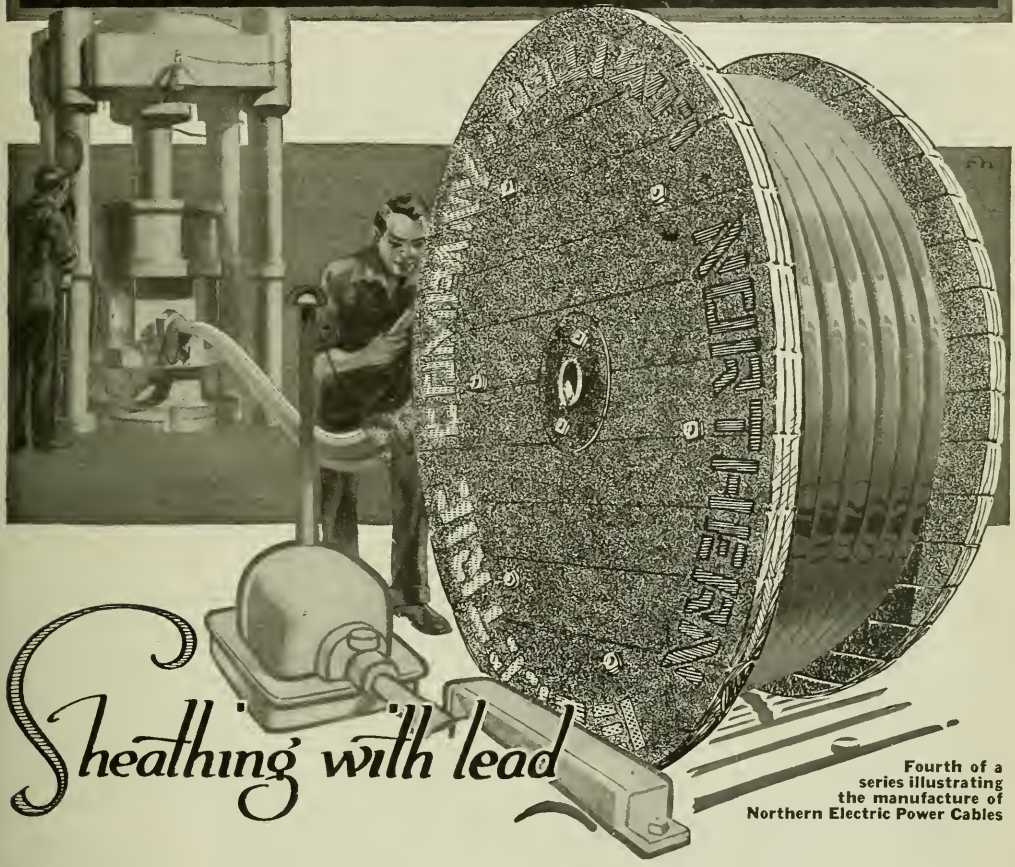
Westfield, N.B.—The town council will probably request the C.P. Ry. and the C.N. Ry. to establish a modern station building on completion of the new valley road.

Westmount, Que.—The Montreal Arena Co. have given a contract for construction of a two-story garage, to be erected on the site of the Arena, destroyed by fire two years ago.

Winnipeg, Man.—Contract has been awarded by the city council, for reconstruction of market building into civic offices, to Fraser & McDonald Construction Co. Contract price, $57,592. Rejected tenders, No. 2, $61,546; No. 3, $62,800; No. 4, $64,132; No. 5, $65,500, No. 6, $65,706; No. 7, $70,500, No. 8, $76,593. M. Peterson, secretary.

Winnipeg, Man.—Contract has been awarded by the city council for erection of a show-room building for the city light and power department to Thos. Kelly & Sons, Ltd., Winnipeg. Contract price, $41,285. C. J. Brown, city clerk.

Northern Electric



Sheathing with lead

Fourth of a series illustrating the manufacture of Northern Electric Power Cables

The Impregnated paper-insulated cable passes from a warm room through a cartridge shaped core and circular die enclosed in the lead press to the cable reel. Great pressure from a hydraulic ram forms the sheath about the cable by forcing pure lead in a semi-molten condition between the core and the die, which are arranged with the proper clearance to give the thickness of lead required. This operation requires very skilful attention. Our long experience in the manufacture of all classes of lead-covered cables ensures for our product, cable sheaths of the highest quality.

MONTREAL HALIFAX TORONTO WINNIPEG REGINA

Northern Electric Company LIMITED

CALGARY EDMONTON VANCOUVER VICTORIA

Power Cables

MISCELLANEOUS

Belleville, Ont.—Contract has been awarded by the Canadian Industrial Alcohol Co., Ltd., for construction of a 30,000 bushel reinforced concrete grain elevator and work house. Contractor, J. B. Nicholson, Ltd., Hamilton, Ont.

Cardston, Alta.—Contract has been awarded, for construction of a soldiers' memorial, to the Lethbridge Monumental Works.

Comox, B.C.—Contract has been awarded by the department of public works, for repairs to wharf, to the Fraser River Pile Driving Co., Ltd., New Westminster, B.C. Contract-unit prices, approximately $17,358.04. R. C. Desrochers, secretary.

Creston, B.C.—The board of trade is requesting the provincial government to immediately complete the survey of the Arrow Creek irrigation ditch and proceed with construction.

Donacona, Que.—The Donacona Paper Co. contemplate extensions to their present plant.

Fort Churchill, Ont.—The government contemplates construction of automatic lighthouses for Hudson Bay and Straits. By this device, horns, sirens and lights are controlled from shore by means of heavy submarine cables Approximate cost of lighthouse, $50,000.

Fredericton, N.B.—Contract has been awarded by the Nashwaak Pulp and Paper Co., for construction of a concrete dam on the Nashwaak River at Marysville, N.B., to the Amberson Hydraulic Construction Co., Ltd., Montreal. Contract price, approximately $50,000. N. M. Jones, general manager.

Halifax, N.S.—The Nova Scotia Steel and Coal Co. has purchased the coal-handling plant on C.N. Ry. terminals at Halifax. D. H. MacDougall, president.

Ingersoll, Ont.—The city council has decided to construct a swimming pool in the northwest corner of the new park on King St. Mayor Buchanan.

Lethbridge, Alta.—The city council contemplate installation of water meters. Approximate cost, $30,000. W. D. L. Hardie, mayor.

New Westminster, B.C.—A cordage company, operated by returned soldiers, will erect buildings valued at $80,000 and install equipment valued at $90,000 upon a site granted by the city council. Mayor Gray.

Odessa, Ont.—Contract has been awarded by the department of public highways, Ontario, for construction of concrete abutments, roadway and sidewalk floors for bridge, to Gibson & McGinnis, Portsmouth, Ont. George Hogarth, chief engineer.

Ottawa, Ont.—Tenders will be received until noon, August 18th, by the C.N. Ry., for construction of concrete culvert, abutments and piers between mileage 59, L'Orignal and Ottawa, on the Grenville subdivision. Plans, etc., at the offices of the division engineers, G.N.W. Telegraph Building, Ottawa, and Tunnel Terminal Station, Montreal. A. F. Stewart, chief engineer, 27 Wellington St. E., Toronto.

Peel Township, Ont.—Tenders will be received until 2 p.m., August 18th, by township council, for construction of municipal drains No. 1 and 2. Quantities to be excavated, 17,804.11 and 6,965 cu. yds. Edward Gainer, township clerk, Arthur, Ont.

Peterborough, Ont.—The city council will consider purchase of an asphalt paving plant. Alderman McIntyre.

Pointe Pizeau, Que.—Tenders will be received until noon, August 28th, by the department of public works, Ottawa, for repairs to wharf at Pointe Pizeau, Que. Plans, etc., at offices of district engineers, post-office building, Quebec; Shaughnessy building, Montreal, and post-office, Sillery, Que. R. C. Desrochers, secretary.

Port Arthur, Ont.—The Sucker Creek Timber Slide Co., Ltd., has been incorporated, $50,000, to construct and maintain slides, booms, piers and other works necessary to the transmission of timber down Sucker Creek in unsurveyed territory. E. J. H. Weldon, provisional director.

Port Hope, Ont.—The contract, previously reported in this column, awarded by the department of public works, Ottawa, to R. Brewder, Cobourg, for repairs to pier at Port Hope, Ont., amounted to $11,565.46, (unit prices). R. C. Desrochers, secretary.

Qu'Appelle, Sask.—Tenders will be received until August 19th, by the Starrs Point Rural Telephone Co., for extensions to system. T. Bray, Box 114, Qu'Appelle.

River Glade, N.B.—Tenders will be received until noon, August 18th, by the board of commissioners, Jordan Memorial Sanatorium, for construction of a fishway at the sanatorium dam. D. A. Carmichael, secretary.

Sarnia, Ont.—The city council contemplates construction of a concrete swimming pool for children. Alderman R. Kirby.

Saskatoon, Sask.—Tenders, separate or bulk, will be received until noon, August 19th, by the board of the Saskatoon school district No. 13, for construction of a school building, exclusive of plumbing, heating and ventilation. Wm. P. Bate, secretary, P.O. Box 1406, Saskatoon. R. Blackwood, architect, building commissioner.

Souris, P.E.I.—Contract has been awarded by the department of public works, for delivery and placing of stone on breakwater, to Phillips & Mutch, Charlottetown, P.E.I. Contract-unit prices, approximately $17,358.04. R. C. Desrochers, secretary.

Stratford, Ont.—The city council contemplate erection of a monument, in Battery Park, as a soldiers' memorial. Plans and a model of the proposed monument were presented by the committee of the Chamber of Commerce. Mayor Stevenson.

St. Thomas, Ont.—The board of water commissioners have decided to construct a large dam on Kettle Creek. The reservoir, so formed, will contain sufficient water to supply the total needs of the city.

Sydney, N.S.—The Sydney Foundry and Machine Co. has applied to the city council for a site near Anderson's Point, on the eastern side of Sydney harbor, Sydney, N.S., for construction of a drydock.

Thessalon, Ont.—Contract has been awarded by the department of public works, for reconstruction of wharf, to A. G. Tweedie, Sault Ste. Marie, Ont. Contract-unit prices, approximately $9,428.75. R. C. Desrochers, secretary.

Toronto, Ont.—No contract was awarded by the highway department, Ontario, for construction of concrete structures on provincial highway between Queenston and Jordon, in the townships of Niagara, Grantham and Louth. One tender was received but was considered excessive and was rejected. W. A. McLean, deputy minister.

Toronto, Ont.—Tenders will be received until noon, August 25th, by the C.N. Ry., for 200,000 railway ties, to be delivered on the Halifax and Southwestern branch. E. Langham, general purchasing agent, Toronto.

Toronto, Ont.—The ratepayers in the districts of Earlscourt, Oakwood, Fairbanks, Harvey and Silverthorne will request the city council to establish a modern firehall to protect those districts.

Toronto, Ont.—Contract has been awarded by the Conger Lehigh Coal Co., Ltd., for construction of a 2,000-ton circular reinforced concrete coal elevator to replace old wooden trestle at Gladstone Ave. and Queen St. Contractor, J. B. Nicholson, Ltd., Hamilton, Ont.

Toronto, Ont.—Contract has been awarded by the department of public works, Ottawa, for reconstruction of a portion of the superstructure of the east pier at the eastern entrance to Toronto harbor, to the C. S. Boone Dredging & Construction Co., Ltd., Toronto. Contract, unit prices approximately $31,095.70. R. C. Desrochers, secretary.

Victoria, B.C.—Tenders will soon be called for the first unit of the Sumas reclamation project. Estimated cost of entire project, $1,500,000.

Windsor, Ont.—The Detroit and Windsor Ferry Co. contemplate construction of a 450-ft. dock, equipped with customs and immigration offices.

The Canadian Engineer

A Weekly Paper for Civil Engineers and Contractors

Hydro-Electric Development on the Seguin River

Municipally-Owned Plant Now Being Constructed for the Town of Parry Sound, Ont., To Generate From 2,200 to 2,900 H.P.—Gravity Type Concrete Power Dam—Concrete Storage Dam at Mill Lake—Initial Expenditure, Approximately $150,000

TWO new concrete dams on the Seguin river, and a new power house with an ultimate capacity of from 2,200 to 2,900 electrical horse-power are being built for the town of Parry Sound, Ont., as a municipally owned public utility.

Parry Sound, located on the east shore of Georgian Bay, has the advantages of water transportation and service by three railways: Grand Trunk, Canadian Pacific and Canadian National. It is a county seat and the centre of an enterprising community. The population according to the last census (1911) was 3,429, but has since increased considerably, and during the war reached nearly 7,500, largely due to the great industrial activity in the neighboring town of Nobel, where plants of Canadian Explosives, Ltd., and British Cordite Co. were located. Since the armistice, business in Parry Sound has been reduced in volume and the town's officials decided that steps must be taken to ensure an adequate supply of power, so that new industries can be attracted to the town and its prosperity maintained.

The firm of C. H. and P. H. Mitchell, consulting engineers, Toronto, was asked to report upon the cost of an increased power supply, and a by-law was submitted to the citizens, who decided by a very large majority to adopt the scheme suggested by the engineers and to begin construction immediately.

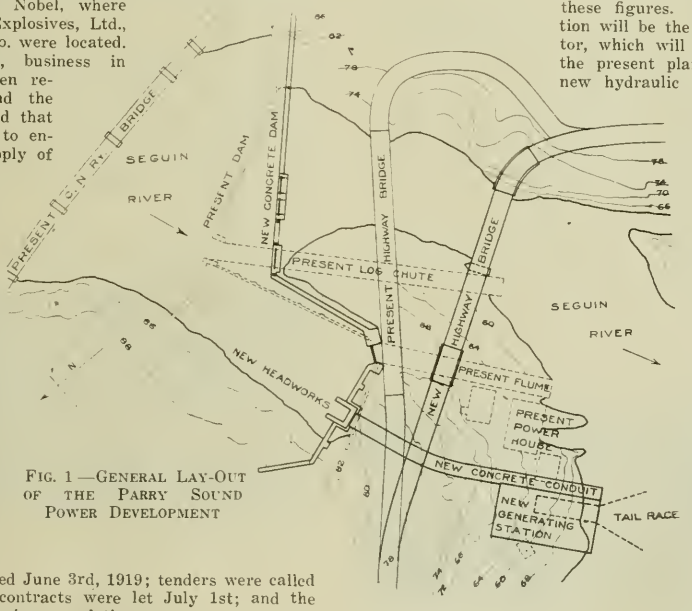


FIG. 1—GENERAL LAY-OUT OF THE PARRY SOUND POWER DEVELOPMENT

The vote was polled June 3rd, 1919; tenders were called to be in June 20th; contracts were let July 1st; and the power dam is now nearing completion.

For many years past the town has owned a small hydro-electric power plant, located very near the site of the plant now under construction. The old plant was rebuilt in 1905 and equipped with a Jenckes hydraulic turbine and an Allis-Chalmers-Bullock generator of 425 k.w. capacity. A concrete dam on the Seguin River was built at the same time, and also a timber storage dam at the outlet of Mill Lake. The town's power requirements are exceeding the capacity of this plant; moreover, the officials dislike being dependent upon a single unit; so, for these reasons, and also those outlined above, it was decided to build the new plant.

The Seguin river watershed, with an area of 425 square miles, includes at least twelve lakes well suited for storage purposes. Conservatively estimating the flow at one cubic foot of water per second for each square mile, with a gross head of 32 ft., 1,200 h.p. (24-hr. power) would be available. Assuming that the load factor of the system would not exceed 50%, the plant would produce 2,400 h.p. on peak, or about 2,250 h.p. of saleable electrical power, and upon these figures the design was based.

The engineers point out that a more complete study of the watershed, with its excellent storage possibilities, may show a capacity much in excess of these figures. The initial installation will be the old 600 h.p. generator, which will be transferred from the present plant and coupled to a new hydraulic turbine, and a new 800 h.p. unit, or a total of 1,400 h.p. By the time the third unit is required, more accurate run-off data will be available, and the third unit, instead of being 800 h.p., may be 1,000 or even 1,500 h.p.

The present plans, however, are for an ultimate installation of at least 2,200 h.p., of which 60 h.p. will be required for the operation of the motor-driven exciters, leaving a net saleable output of 2,140 h.p. This is not taking into account the generator overload capacity of 400 h.p. With the initial installation of 1,400 h.p., allowing 40 h.p. for exciters, the net saleable output will be 1,360 h.p., not including the generator overload capacity of 200 h.p. The generator station provides room for the installation of a third unit of any probable required capacity.

Between Mill Lake and the head water, there is 5 ft. difference in level. At the new development there will be a gross head of 32 ft. The difference in level between the new tailrace and Parry Sound, which is an arm of Georgian Bay, is 8 ft. It may be mentioned that there is a power development, owned by the Parry Sound Lumber Co., on the Seguin River between Georgian Bay and the town's plant.

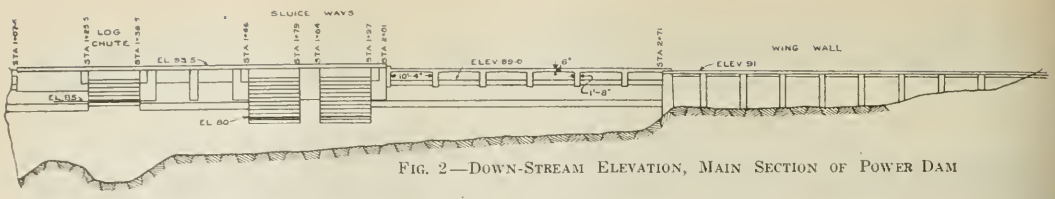


FIG. 2—DOWN-STREAM ELEVATION, MAIN SECTION OF POWER DAM

The engineers considered the possibility of building a higher power dam and thus obviating the necessity of a new dam at Mill Lake, and also increasing the working head. By raising the dam another 5 ft., a head of 37 ft. could have been obtained, but there would then have been a greater area under flood below Mill Lake. It was estimated that the land damages, including the necessary removal of the C.N.R. tracks, would cost more than the value of the additional power that would be obtained as a result of the higher head. It was thought that a much smaller sum would give as much

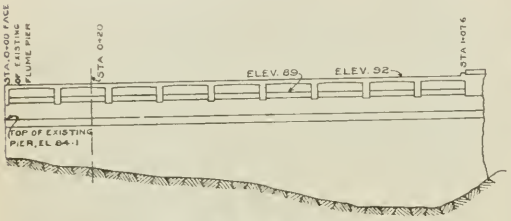


FIG. 3—SECTION OF POWER DAM BETWEEN PRESENT LOG CHUTE AND PRESENT FLUME

additional power if expended in other ways; that is, by stricter conservation of the waters of the upper lakes, thus increasing the possible average flow.

The town owns all the rights on the whole watershed, having looked forward for many years to its possibilities for greater power development, and having eventually acquired entire control. Employees of the town maintain all the dams on the lakes, and attend to their regulation.

The new power dam is being constructed immediately below the present dam, and has a good rock foundation. It will raise the water 6 ft. above the crest of the present dam. This will bring the water within 2.8 ft. of the C.N.R. bridge girders, or, in flood periods, to within 2 ft. of the

FIG. 4—OLD DAM AND HIGHWAY BRIDGE, LOOKING DOWN-STREAM

girders. It was hoped that the old dam might be utilized in the construction of the new works, but upon examination it was found that its condition did not warrant further use, and it has been entirely abandoned. The new dam is so placed that the present plant need not be shut down until the new plant is ready to be operated. The entire works will be constructed, ready for operation, before the final gap in the new power dam will be closed, shutting off the supply to the present flume. This is shown by Fig. 1. After the new unit is in operation, the old generator, exciter and

FIG. 5—NEW POWER DAM, LOOKING UP-STREAM

switchboard will be moved from the present plant to the new one and the present timber flume will be dismantled.

The dam is of solid gravity type. The crest has an overflow weir 160 ft. long, two sluiceway openings, and a log chute opening, these three openings being closed with stop-logs. In addition to these, there is a regulating sluiceway with a geared gate.

The present forebay, which has been very effective in taking care of ice, is being retained and the present flume opening will be used as an ice overflow and sluiceway.

With all the sluices and weirs, floods up to 5,000 c.f.s. can readily be passed, and this

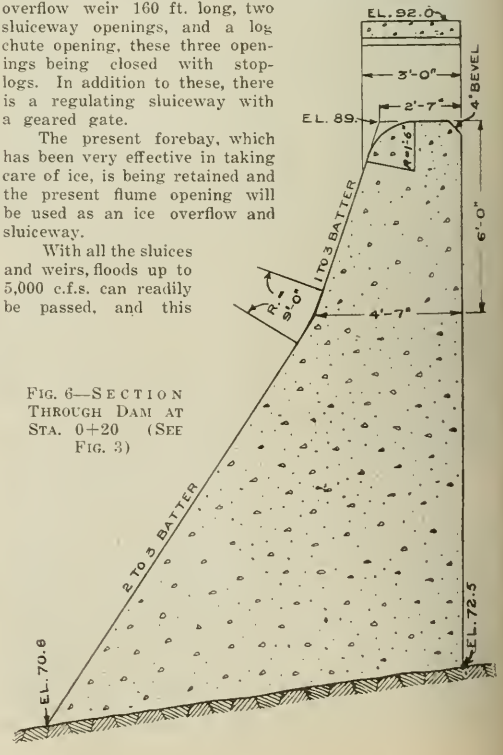


FIG. 6—SECTION THROUGH DAM AT STA. 0+20 (SEE FIG. 3)

flood capacity is said to be in excess of any flood likely to occur after the Mill Lake dam has been rebuilt and other storage dams have been put in place.

The headworks intake leads to a reinforced concrete conduit, box section, 9½ by 10 ft., through which the water flows to the power house. The intake is being equipped with gates, racks, ice and debris outlet, etc., and is housed.

The turbines will be set in open concrete flumes and will be of standard horizontal type, equipped with Lombard oil

FIG. 7—VIEW ACROSS OLD POWER DAM, SHOWING HEADWATER AT RIGHT AND LOG CHUTE

pressure governors. The generator aisle will be used only for the three generators. The switchboard gallery is raised 21 ins. above the floor and projects into the generator aisle, so that the operator will have a clear view of all equipment. The exciters are adjacent to the switchboard gallery. An overhead travelling crane will serve the generators and hoisting gear will be arranged for the flumes and for the erection and adjustment of the turbines. The switchboard will consist of generator and exciter panels, feeder panels, series street lighting panels, etc., and will be equipped with an automatic voltage regulator. The power house and gate house will be of reinforced concrete.

FIG. 8—NEW POWER DAM UNDER CONSTRUCTION

The Mill Lake dam will be replaced by a concrete dam of the same height, containing log chute, overflow weir, sluiceways and a submerged gate.

The road en route to Mill Lake will be flooded at one place as a result of the higher power dam, and this will require 6 ft. of fill for a length of 400 ft., and the construction of a culvert.

As can be seen from Fig. 1, there is at present an old highway bridge across the river just below the power dam. While the necessary new bridge could be carried on the power dam, that would entail considerable detour and steep grades. Bearing in mind proper town planning requirements, eliminating such detours and grades, it has been decided to build a new bridge, costing $15,500, below the present one.

Following are the costs as estimated by the consulting engineers, and it may be stated that all the contracts have been awarded within the estimates:—

Power dam, including sluice gates, etc., and cofferdams	$ 18,500
Head works, north wing wall, conduit, intake and water metering equipment	14,500
Generating station, flumes, gates and tailrace	32,800
Crane and hoist	2,500
Removal of flume, resetting log chute, etc.	750
Two turbines, one 1,050 h.p. for new generator, and one 650 h.p. for present generator, with governors, installed	19,200
Generator, 600 kw., installed	11,000
Resetting present generator and exciter	300
Motor generator exciter set	2,000
Switchboard, including rebuilding of present switchboard, wiring, etc.	6,750

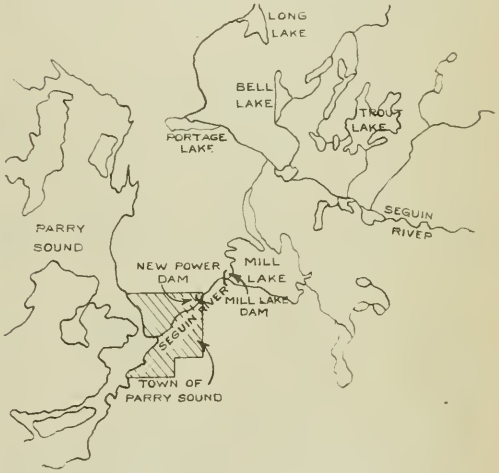


FIG. 9—MAP OF THE PARRY SOUND DISTRICT, SHOWING COURSE OF THE SEGUIN RIVER AND LOCATION OF NEW DEVELOPMENT

Voltage regulator	1,700
Mill Lake dam	6,500
Raising level of road and culvert	1,000
Allowance for contingencies	6,500
Engineering	7,000
Interest during construction	4,000
Land damages above power dam	15,000
Debenture issue	$150,000

(Six per cent. bonds sold at 101.75)

Annual Generating Charges

Following are the estimated annual charges:—

Annual charge on debenture issue	$ 11,250
Annual charge on balance outstanding ($30,000) on old debentures issued in connection with present power plant	2,225
Maintenance and repairs	3,000
Supplies, oils, etc.	500
Operation	3,600
Insurance	400
Annual generating plant charges	$ 20,975

With an output of 1,360 h.p. (neglecting the overload capacity) this would mean an annual power cost on the switchboard of $15.50 per h.p.

If the third unit be identical with the initial new unit, the cost on this installation will be, at present prices:—

Turbine with governor	$ 11,500
Generator	11,500
Switchboard and wiring	2,000
Total	$ 25,000

The additional storage capacity required throughout the watershed for supplying the three units, together with attendant land damages, is estimated at $25,000, or total cost of $50,000 for an additional saleable output of 780 h.p. (neglecting overload capacity). On this, annual cost would be $4,450; or for the 2,140 h.p., the total annual cost would be $25,425, or $12 per h.p. It is confidently expected by the engineers, however, that with extensive storage on the watershed, a greater power capacity would be available, and that the third unit could be larger without appreciable additional cost for machinery. For instance, if the third unit is 1,500 h.p. instead of 800 h.p., the additional cost over the above figures would be $20,000, on which the annual charges would be $1,600. This would yield 2,830 h.p. at a total annual cost of $27,025, or somewhat less than $10 per h.p. at the switchboard.

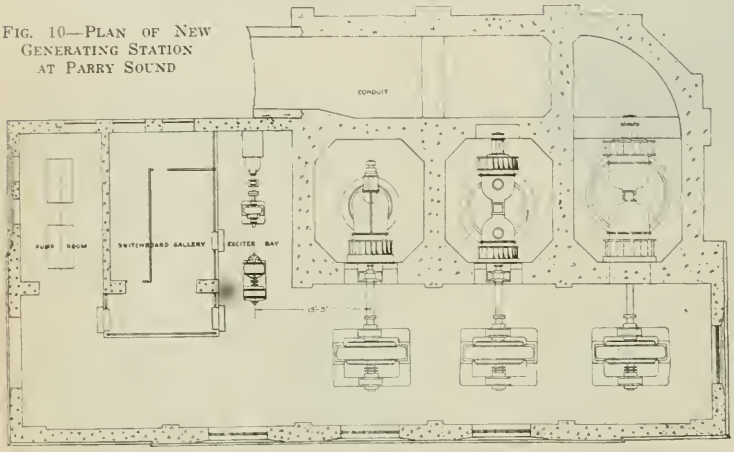


FIG. 10—PLAN OF NEW GENERATING STATION AT PARRY SOUND

FIG. 11—EXCAVATION FOR TAILRACE AT GENERATING STATION SITE

R. W. Harris is the resident engineer for C. H. and P. H. Mitchell, who are supervising the construction of the plant. Geo. Groves is superintendent of the Parry Sound Electric Light and Power System. The general contractors are W. M. Fletcher & Co., of Toronto; the contractors for the electrical equipment are the Canadian Westinghouse Co., Ltd., of Hamilton; for the hydraulic equipment, the Boving Hydraulic & Engineering Co., Ltd., of Lindsay.

TRACK LIFTED FOR MILITARY USE

OVER 23,000 tons of steel were lifted from the roadbeds in Canada during the war and shipped overseas, according to the report presented to the Dominion government by Alex. Ferguson, engineer in charge of lifting rails for war purposes. Mr. Ferguson's report follows:—

On the 21st of May, 1917, instructions were given to proceed with the work of lifting track from the roadbeds of the Grand Trunk Pacific and Canadian Northern railways, between Imrie and Resplendent, Alta., in order to provide steel rails for the use of His Majesty's armies in France. An organization was immediately created, and the work of lifting track and of transforming the two lines into one commenced.

The Grand Trunk Pacific track, between Imrie and Leaman Junction, 13.6 miles; between Obed and Pocahontas, 42.25 miles; and between Geikie and Resplendent, 34.8 miles, was lifted, and the rails and angle bars shipped to Three Rivers for shipment to France.

The Canadian Northern track between Leaman Junction and Obed, 79.9 miles, and between Snaring Junction and Geikie, 22.05 miles, was lifted and the rails relaid on the Grand Trunk Pacific roadbed, between Leaman Junction and Obed, and between Snaring Junction and Geikie, thus releasing the Grand Trunk Pacific rails and fastenings for war purposes as required by order-in-council.

The track of the Grand Trunk Pacific between Pocahontas and Snaring Junction was lifted and relaid partly with 60-pound steel and partly with 80-pound Canadian Northern steel in order to release the Grand Trunk Pacific steel for shipment to France, and at the same time preserve rail connection with the coal mines at Pocahontas. This portion of the Grand Trunk Pacific line is being operated as a spur and is, as yet, considered merely temporary. A rearrangement of the main lines may be found necessary in the interests of economy.

The first shipment of steel rails for Three Rivers left Edmonton on the 17th of June, 1917, and the last on the 26th of October, 1917. The total shipments amounted to 23,408 gross tons of rails and 1,110 gross tons of angle bars.

During the months of October, November and December, 1917, a considerable amount of work was done on the construction of highways between Otley and Carrot Creek, and between Peers and Fulstow, in order to give the settlers access to the Grand Trunk Pacific line. Before the close of the fiscal year arrangements were made for the completion of these roads and for the construction of a roadway from Rosevear, on the Grand Trunk Pacific, to Horner.

The tenders which were received last Monday by the Department of Public Highways, Province of Ontario, for the construction of about 65 miles of bituminous roads, have been opened and the contracts awarded, but the department states that it will be impossible to give out any information regarding the list of bidders, prices or names of successful contractors until the provincial cabinet has approved of the awards suggested by the department.

Water Power Policies of the Quebec Government

Goodwill of Ontario and Federal Officials Needed to Solve Some Difficult Problems—Emphyteutic Leases from 9 to 99 Years — Many Undeveloped Powers in the Province—Address at the Annual Meeting of the Union of Canadian Municipalities

By ARTHUR AMOS
Chief of the Hydraulic Service, Province of Quebec

CANADA'S water-powers! Quebec's water-powers! What alluring words, to a great many promoters; what promises, to a great many prospectors! One might almost think that a waterfall is as valuable as a gold mine. I might state immediately that such is not my opinion. Once a gentleman very much interested in water-powers and who had obtained a valuable grant from the government, came to my office and said: "I think that a power concession is merely an authorisation to spend a lot of money."

I do not agree with that statement either, although I do believe that a person wishing to obtain a water-power grant must be well organized financially and gifted with an energetic character and much perseverance in order to be able to realize a development. Anyone who has tried to acquire flooding rights will no doubt agree with that statement.

In my province there are still, of course, a great many undeveloped power-sites, both in the populated districts and northward in the great uninhabited New-Quebec.

Recently the Hydraulic Service was called upon to make a statement regarding the assets of Quebec in this regard, and it was thought proper to consider separately the power-sites that might be useful to the present generation and those that would only benefit our grandsons. This division line was fixed along the 50th parallel, so a glance at the map will show that we have practically admitted that more than two-thirds of the powers of the province are out of reach for the time being.

Incidentally, I was not quite right in doing so, for we have actually issued a lease for a water-fall near the 57th degree of latitude, about as far north as the middle of Hudson Bay!

Nevertheless, we have roughly estimated the energy of the water-falls below the 50th parallel to represent, in round figures, 5,000,000 h.p. If we assume that the remainder of the province is equally well provided with water-falls, it would then have some 10,000,000 h.p. scattered in the wilds of the Labrador and Ungava districts; but these figures are merely hypothetical, and personally I do not attach great importance to them; I believe rather that we had better concentrate our thoughts and abilities on the sites that are at our very doors and waiting on our initiative to supply us with all the commodities that their energy represents.

Two Classes of Rivers

To that end, the concurrent goodwill and best brains of our governments, at Ottawa and at the provincial capitals, must unite in order to find the means of solving the many difficult problems that are involved.

As you know, rivers are of two classes, the navigable ones and the non-navigable. Although this division is simple enough, yet innumerable disputes have from time to time arisen owing to the difficulty of getting a correct definition of what is a navigable stream. For instance, I may mention the case of the Ottawa river, which was declared navigable near Ottawa, at Table Rock, only by three judges against two, in the Appeal Court. If a river be navigable, then its bed is vested in the provincial government, notwithstanding the fact that the federal government controls the works that may be built thereon.

Consequently, any applicant for power on the St. Lawrence, the Ottawa or the Saguenay, for examples, must negotiate with at least two governments. In the case of the Ottawa river, the third government, that of Ontario intervenes, as this river is the interprovincial boundary.

It may therefore be seen that it would be desirable that as regards such rivers, a uniform policy should prevail, and that similar conditions by the three authorities would be of great advantage to prospective users. Possibly, however, it would be better not to discuss difficult cases but preferable to state what is done regarding other rivers where only one government has charge.

I have stated that the rivers are divided into two classes, navigable and non-navigable. The beds of non-navigable rivers are either private property or form part of the public domain. Before 1884, the Quebec government granted land lots bordering rivers without any special reserve in regard to the water rights adjoining these lots. It followed that when a settler had obtained his letters-patent, he became *ipso facto* proprietor of half the adjoining stream. In consequence a good many water-falls thus passed into private property and were developed at an early date. In 1884, owing to disputes for water rights, the government became aware of the value of water-powers, and a law was passed creating a reserve, in favor of the Crown, three chains in width (about 200 ft.) along all non-navigable rivers.

The result was that, remaining riparian owner since that date, the Crown retained all rights in the bed of streams, and its leases on such rivers do away with many former troubles. To give a short account of these government leases:—

History of Quebec Leases

Originally (about 1867) the sites were sold outright for practically a nominal sum as mill sites. Then, some thirty years later, or about 1897, somewhat more severe conditions were imposed and prices were raised a great deal. Such was the case of the great Shawinigan Falls, sold for $60,000 with the obligation of spending $3,000,000 within a few years. Then about 1909, the principle of the emphyteutic lease began to be applied, and since that time has been generally adopted almost to the exclusion of sales.

I do not know whether emphyteusis is well known outside of the province of Quebec, so I will explain what it means in a few words. It is a contract by which the proprietor of an immovable, conveys it to another for a time which cannot be shorter than 9 years nor longer than 99 years, the lessee binding himself to make improvements, to pay the lessor an annual rental, and to pay such other charges as many be agreed upon. This sort of lease differs from other leases by the fact that the lessee (provided he fulfills his obligations) becomes the real proprietor of the object conveyed, to all intents and purposes; he can sell or mortgage the property, and make any improvements he wishes. At the end of the lease the lessor takes back the property, as well as the buildings thereon, and may then enjoy all the improvements made unless he wishes to renew his contract. I shall not further discuss emphyteusis, as full details may be found in the civil code.

Such has been the policy adopted by the Quebec government for the last ten years and the public seems to like it. Rentals from those leases have been growing from year to year. In 1914, they amounted to $10,000; they reached $72,000 in the last fiscal year.

There is also another important source of revenue derived from rivers; it is the so-called stored water. There are several regulating reservoirs in the province. The first ones were built by the Public Works Department in the upper Ottawa, at the foot of Lake Temiskaming, at the foot of Lake des Quinze, and at the two outlets of Lake Kipawa. The others were built by the Quebec Streams Commission at the headwaters of the St. Maurice, at the outlet of Lake St. Francois, and a smaller one on the Ste. Anne de Beaupré River.

The St. Maurice River reservoir, which has lately been named the Gouin reservoir, is by far the largest of all. In fact it stores more water than is held by the Assuan dam built by the Imperial government on the Nile. So far it has permitted the commission to double the minimum flow of the St. Maurice, in accordance with its contract with the mill owners; and I have reason to believe that it will be possible to increase substantially this proportion.

The project cost about $2,500,000, including various accessory works such as a hydro-electric plant capable of developing 1,000 h.p., a railroad 20 miles in length, etc. This reservoir is at present yielding a revenue of $191,000 per annum just from the three companies now using it.

Storage Profitable for Province

After subtracting interest on the capital and an annuity for a sinking fund to redeem our bonds in 30 years, we had this year a net profit of about $25,000. Bearing in mind that there are still many rapids and falls available on the river, and that several of them will likely be developed in the course of the next 10 to 15 years, it may be seen that the proposition is a good one both for the government and for the users of the water.

The method adopted to collect the revenue was based, after mature consideration, on the horse-power-year. This expression needs a word of explanation. The minimum flow occurs in the fall and again in the winter months. The reservoir is consequently closed some months in the year and only opened in times of drought. The water given out in those dry months is calculated as though it was evenly distributed throughout the year; by a simple calculation it may then be converted into horse-power according to the head at each power-house. Such is at present the policy of the government as regard water-power and storage reservoirs.

I have not referred at any length to the undeveloped water-powers of Quebec for the reason that I have treated the subject already in a little booklet entitled, "Water-Powers of the Province of Quebec," which was printed in 1917, by the Department of Lands and Forests of the Province of Quebec, and which will be mailed free to anybody applying for it.

Permit me to sum up the situation by saying that the province of Quebec is well provided with water-powers, as is well known, but that most of its falls are not of great height.

It should be especially observed that the sites where considerable energy (over 50,000 h.p.) can be produced, and which are still in a natural state, are remarkably situated for supplying the wants of the principal cities. Thus, for the vicinity of the city of Ottawa, we find the Chats Falls and other rapids of the Ottawa River; for Montreal, besides the sources of energy now in use, the rapids of the St. Lawrence at Coteau, Les Cèdres, and also the Sault-Saint-Louis, commonly called Lachine Rapids; for Trois-Rivières and Quebec, the water-powers of the River St. Maurice, regulated by the largest reservoir in Canada; for the Saguenay and Chicoutimi region, the rapids of the Grand-Décharge, the outlet of Lake St. John; and lastly, for Lower St. Lawrence, the falls of the Manicouagan and of the River Aux Outardes.

Wonderful Opportunities at Lake St. John

The south shore of the St. Lawrence is not so well provided, but it may be said that for the more densely populated regions, that is to say the Eastern Townships, the St. Francois River, which is regulated, will suffice for the demand for a good many years.

The advantages of the Lake St. John region and, particularly, those of the Grande-Décharge, should be especially emphasized. The national conditions there are remarkable; the available undeveloped power is enormous; ocean navigation is possible almost as far as the site where the works would be erected; there is no lack of labor and a railway, as well as a steamer line, connects the district with Quebec and Montreal.

The Quebec Streams Commission, acting under the jurisdiction of the provincial government, has taken in hand the improving of the regimen of rivers on which industries are established. Great advantages are anticipated from this policy, and everything tends to show that within the next decade the work of this body will produce all the good results expected from it.

The question of public ownership is very much to the fore these days. I do not think, however, that it is within my jurisdiction to discuss this matter here, although I may say that the Quebec government has already made grants to a certain municipality on the general policies outlined above So far as I know, this has been found satisfactory to the people of the town concerned, and no other special favor has been asked. I would be pleased to furnish anyone privately with any further details that might be desired, concerning the water-power situation in the province of Quebec.

Letter to the Editor

PROF. BLANCHARD'S APPOINTMENT

Sir,—I wish to advise your readers of the action of the Board of Regents of the University of Michigan in the matter of reorganization of the work in highway engineering at Michigan University.

At the last meeting of the board, the professorship of highway engineering was created and filled by the appointment of Prof. Arthur H. Blanchard, late of Columbia University. Prof. Blanchard is so widely known as a teacher and engineer in matters of highways and highway transport, that I need say nothing as to his qualifications.

Funds were also provided for the appointment of an assistant professor of highway engineering who will have charge of the highway laboratory and courses in design, laboratory and field work. This position will be filled by the appointment of John H. Bateman, a graduate of the University of Michigan, and for the past four years assistant engineer and engineer of the Michigan State Highway Commission.

The regents have made liberal appropriations for equipment, current expense and for the salaries of clerical and laboratory assistants.

The University of Michigan four years ago commenced to develop work in highway engineering, and the work in the university and the laboratories has been built up to a good state of efficiency under Prof. John J. Cox, who recently resigned to devote his whole time to construction work.

A large program of work under Prof. Blanchard will include the continuation of all work formerly given undergraduate students in highway engineering, together with one or two new courses, the addition of courses in highway transport and highway economics, the development of graduate work during the regular collegiate year, and the continuation of the highway short course which has been given at Michigan University for the past five years.

In addition to this work, special courses for graduate practicising engineers, leading to the master of science degree in engineering, will be given during the winter months. These courses will be given intensively so that engineers who can only take a few months away from their practice may take the work and secure credit towards the degree.

It is the intention and desire of the authorities of the University of Michigan to give the most ample support to the work in highway engineering as being a subject which demands attention at the present time.

HENRY E. RIGGS,
Professor of Civil Engineering,
University of Michigan

Ann Arbor, Mich., August 13th, 1919.

The Rust Engineering Co., of Pittsburgh, Pa., have been awarded contract for a radial brick chimney for the Ames-Holden Tire Co.'s plant at Kitchener, Ont.; also contract for four chimneys for the Imperial Oil Co.'s refinery at Dartmouth, N.S.

HORSEPOWER REQUIREMENTS OF CENTRIFUGAL PUMPS

THE water horsepower requirements of a centrifugal pump may be easily determined when the quantity to be pumped and the total head are known. However, it is necessary to have some idea of the efficiency of different sizes and kinds of pumps before the actual horsepower for the driving motor can be specified. Useful information on this subject is given by T. M. Heermans, mechanical engineer, centrifugal pump department, Allis-Chalmers Manufacturing Co., in a recent issue of "Power," from which the matter following has been taken.

The efficiencies in the accompanying table are conservative and can be used in estimating the horsepower required for well-designed pumps operating at suitable speeds against moderate heads.

The usual practice in fitting motors to centrifugal pumps is to allow 10% leeway over the horsepower that it is figured will be required.

Starting Requirements

Besides knowing the size of motor to put on a pump, it is necessary also to know something about the starting requirements of centrifugal pumps and how they affect the selection of the type of motor and also the starting apparatus to be used. Centrifugal pumps are started up quite easily and are generally considered "light starting duty for a motor." Consequently, squirrel-cage motors, and even synchronous motors that do not have much starting torque, can be used to drive centrifugal pumps, but this statement needs a little explanation. The curves of Fig. 1 are typical of the performance characteristics of three different types of centrifugal-pump runners. Chart A is for a standard single-stage centrifugal pump fitted with a runner having a rising horsepower characteristic. By slightly changing the runner design, this pump can be made to have a horsepower curve that is practically flat after the point of maximum efficiency. Chart B is representative of the ordinary type of multistage pump with diffusion vanes, and chart C shows the characteristics of a single-stage pump with a so-called Francis type runner which is particularly designed so that relatively high pump rotative speeds can be employed for low heads. These curves have been reproduced to show in particular the "shutoff horsepower" of different kinds of pump runners. This is the power required to rotate the pump runner at rated speed in the pump casing when full of water but when no water is allowed to be discharged, as would be the case when the pump is started up with the valve in the discharge from the pump closed. The shutoff horsepower has been indicated as a certain percentage of the horsepower required at the highest point of the curve, which has been taken as 100%.

CONSERVATIVE EFFICIENCIES FOR PUMPS OF VARIOUS CAPACITIES

Size of pump In.	Normal capacity, G.P.M.	Efficiency single-stage heads up to 150 ft. Per cent	Efficiency multi-stage heads above 150 ft. Per cent
2	100- 150	50	45
3	200- 350	55	50
4	400- 600	60	56
5	650- 900	65	62
6	950-1,300	70	68
8	1,500-1,800	72	70
10	2,000-3,000	75	72
12	3,500-4,500	76	73
14	5,000-6,500	77	74
16 and over		78	75

Slip-ring or shunt-wound direct-current motors will start pumps having the characteristics shown by all three curves, and squirrel-cage motors also have been found capable of starting these pumps, although in the larger sizes and sometimes for pumps having the characteristics shown by chart C, squirrel-cage motors will take too much current in starting to be used. Standard synchronous motors will ordinarily start pumps having the characteristics of chart A, and develop the necessary torque to pull into synchronism when up to speed, but will have to have specially constructed motors to develop the 50% of rated horsepower required to pull pumps having the characteristics of chart B into synchronism, and cannot be used at all, except by making special arrangements, to start pumps having the characteristics shown in chart C.

The special arrangement just mentioned is to equip a pump so it can be started up empty and then primed after being brought up to synchronous speed. What is done is to provide some means of lubricating the close clearances in the pump until it can be primed, when the water will provide the lubrication. The necessary arrangements can be made easily on single-stage pumps, but it is rather difficult to fix up the multistage type. For this reason they are seldom started up empty, although clutches are sometimes employed.

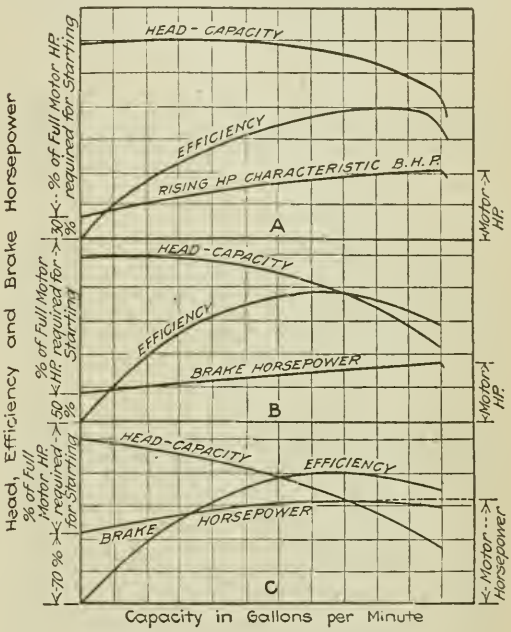


FIG. 1—PUMP CHARACTERISTIC CURVES

All the previous remarks apply to pumps that are started up with a closed valve in the discharge. As a general rule this should be figured on, as otherwise starting conditions will be much worse. It is necessary only to refer to the curves again to see that where no discharge valve is provided, the motor in coming up to speed has also to come up to full horsepower and be thrown on the line at full rating instead of at a fraction of full horsepower. This is not good practice and is bad for the motor even if undue disturbances will not be caused in the line. Instances have been known where the heavy surges of current to start squirrel-cage motors attached to centrifugal pumps without any valve in the discharge have in time loosened up the motor coils.

Kinds of Motors Used

Having considered the power required to start and operate centrifugal pumps, brief reference will be made to the kinds of motor used for pump drive. This is a large subject in itself and should be taken up in detail in separate articles. Probably the motor most commonly used to drive centrifugal pumps is of the squirrel-cage induction type. This motor,

on account of its simplicity and also because the starting duty of a centrifugal pump is not heavy, is used to drive the majority of small and moderate-sized pumps.

In sizes over 150 h.p. and in many cases less, the slip-ring induction motor is used instead of the squirrel-cage type, because it takes less current from the line in starting. Also power companies often fix the maximum size of squirrel-cage motor they will allow to be connected to their lines. In still other cases where a system does not have much capacity, throwing a large squirrel-cage motor on the line would cause serious disturbances and possibly a voltage drop that would be enough to prevent the motors coming up to synchronous speed. These cases call for the use of slip-ring motors. This type is used sometimes when a moderate amount of speed control of the pump is required, possibly to maintain a constant pressure with a variable discharge or to maintain a constant discharge with varying heads.

High-Speed D.C. Motors

Direct-current motors as well are used where speed variation is required, but for constant-speed service are not used so much as induction motors. Then, too, for moderate heads standard centrifugal pumps ordinarily run at higher than the best direct-current motor speeds. However, relatively high-speed direct-current motors are now being built that can be used as satisfactory pump drives where only direct current is available.

As a fourth kind of pump drive, synchronous motors are just beginning to receive deserved attention. Many centrifugal pumps, because they offer a constant steady load, present a fine opportunity for using a large synchronous motor to keep up or correct the power factor of a power system, and by using proper care suitable synchronous motor-driven centrifugal pumps can be often selected.

Troubles Traceable to Pump

Before leaving the subject of the horsepower requirements of centrifugal pumps as related to motor drive, possibly it will be well to point out a few troubles that are sometimes encountered with motors and that are traceable to the centrifugal pump. The most common difficulty, which has been mentioned previously, is operating an improperly selected pump at less than the rated head. This will overload the motor and cause it to run hot. Another trouble almost as common is pump and motor out of alignment due to improper erection. This causes vibration and hot bearings and wears out rapidly the coupling bushings. A third trouble sometimes experienced and resulting in hot motor bearings, is when the centrifugal pump develops an end thrust, causing collars on the shaft to rub on the ends of the bearings. End thrust may develop in a single-stage double-suction pump on account of one side of the runner becoming partly obstructed or an obstruction lodging in the suction passage on one side, which unbalances the runner. Unequal wear of the runner wearing rings on opposite sides of a double-suction runner or displacement of the runner slightly to one side of the centre line of the casing also will cause thrust. In multistage pumps thrust is generally caused by failure or partial failure of the arrangements provided to balance the end thrust. Two pumps taking their suction from the same suction pipe or discharging into the same discharge line, if they are not properly arranged and do not have the right kind of characteristics, can cause trouble by dividing the work unequally, but this and similar questions are outside the scope of this article.

Unit Considered in Entirety

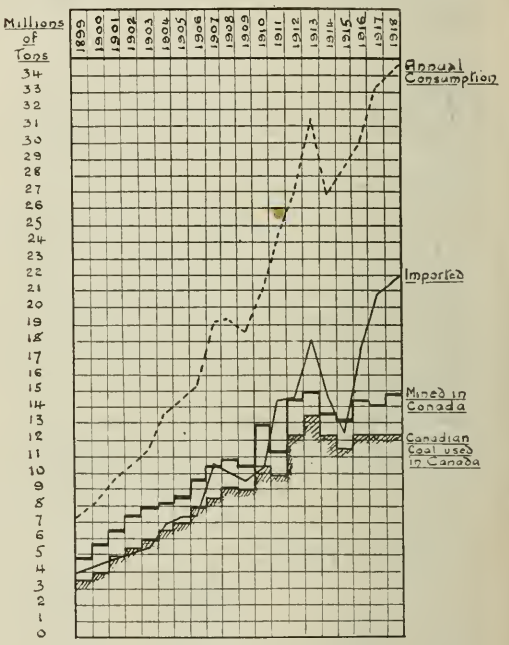
It can be safely stated that a pump should not be bought merely as a pump of a certain size without any reference to the work it will have to do. In conjunction with the driving motor it should be selected to do certain definite work to the best advantage. It is therefore preferable to buy pumps that have been tested carefully and their characteristics determined, with motors of suitable size to run the pumps under all the conditions that will be met with in service. That is, a pump and the drive should be considered as a unit and selected accordingly.

PRODUCTION OF COAL IN CANADA*

By F. D. Gray

THE accompanying graph was compiled from Department of Mines statistics. It shows that up to about 1912 the Dominion was able to furnish from its own coal-seams a little better than half the tonnage of coal consumed for all purposes in Canada. Actually, however, this was not the case, as a certain amount of coal was exported, chiefly from the Cape Breton mines to Boston, Mass.

During the period 1886 to 1899, the coal imported into Canada averaged a little over 54% of the total coal consumption of the country. During the period of 1899 and 1918, included in the graph, the same percentage was maintained, but during the war period the percentage of coal imports was greatly increased. At the present time the imports have risen to 63% of Canadian consumption of coal.



Production and Consumption of Coal in Canada

The coal consumed in Canada during 1918 is estimated at 34,840,000 tons, the highest figure recorded in Canadian statistics, and most closely approached by 1913, when 31,582,545 tons of coal were consumed.

The consumption per capita shows a steadily rising figure, and this is encouraging as showing Canada's progress in the industrial arts and in the conveniences of civilized life, but the discouraging feature disclosed by a study of the statistics is that the Dominion is rapidly increasing its importations of coal, at higher prices than have ever prevailed in the past, and at the same time the home production of coal shows a stationary and even a declining tendency. Any form of production in Canada that is stationary is unsatisfactory and is equivalent to a declining production when viewed in relation to the general growth of population.

There is a difference between the jump in coal consumption that marked 1913, and the peak figure of 1918, namely that in 1913 Canadian coal-mines were increasing their outputs coincidentally with the increase in coal im-

(Concluded on page 247)

*From "Iron and Steel of Canada."

GENERATOR FIRES*

ONE of the side issues brought into existence by the sustained overloads carried during the war service, is the question of fires, their origin and the best means of handling them, and in view of this, a questionaire was circulated by the sub-committee of the N.E.L.A., early this year, giving the following results:—

Some 30 companies reported 81 fires in the past five years; 21 fires equally divided between 60 and 25 cycle units, were specifically described occurring in units ranging from 3,300 to 35,000 kw., and from 2,300 to 13,200 volts.

About an equal number of fires appeared to have started within the insulation and external to the insulation. The greater proportion of fires external to the insulation seems to have occurred on 3-phase systems operating without a grounded neutral. Other causes are many, principally short circuits and grounds, with the remainder from mechanical causes, eddy currents, moisture, etc.

The consensus of opinion is that more frequent inspection and cleaning of the generators is very desirable and has a direct bearing on the liability to fires from sources external to the windings. Too many companies appear to trust the air washing devices for this work, but even with the best possible apparatus, air and grease creep in, fluff and dirt accumulate and conditions for potential fires exist. Good practice, therefore, would indicate periodical cleaning.

Grounding of the Neutral

The grounding of the neutral of 3-phase systems solidly or through resistance, is rapidly becoming standard practice on both 25 and 60 cycle throughout the country.

Twenty-one of the 30 companies replying favor this method of operation; five operating with solid ground system prefer to operate through resistance; three companies oppose the grounding of the neutral. The consensus of opinion seems to be that grounding is very desirable and, in addition to other advantages, has a considerable effect in the reduction of generator fires occurring external to the insulation of the conductors.

It is also rapidly becoming standard practice, particularly on large units, for the manufacturer to bring out both ends of each phase winding to the generator terminal board so as to permit the installation of current transformers between the terminals of phase windings and the neutral of the coils. The current transformers can be connected differentially with respect to the instrument current transformers in the leads between main oil switch and generator, so that in the event of a fault in the generator or its leads, the balanced relay will immediately open the main oil switch, the neutral switch if closed, and, after slight delay, the field switch.

Twenty-four of the 30 companies reporting approve the installation of balanced relay protection and have adopted it as standard practice on all new generator installations and on older generators where the expense involved is not too great.

Fires in Turbo-Generators

The modern type of turbo-generator is usually completely enclosed and the blower action of the ventilation is such that fires are apt to become serious and very difficult to extinguish. As in the case of most fires the time element is the main factor in control. It is especially important to apply the extinguishing medium as promptly as possible, and as close to the seat of trouble as can be done without permanent injury.

This leads to the question of ways and means of fire fighting. Water, steam and carbon-tetrachloride are looked upon with favor, the standard ways of applying being to pipe these mediums up to the end bells.

*Excerpt from annual report of the Canadian Electrical Association's Committee on Electrical Apparatus. Members of the committee: J. F. Neild (chairman), W. H. McIntyre, C. J. Porter, M. D. Schwegler and J. S. H. Wurtle.

PRIVATE WELLS AND PRIVY VAULTS*

By Robert E. Tracy
Director, Bureau of Governmental Research, Chamber of Commerce, Indianapolis, Ind.

IT is a far cry from the privy council to the privy vault, and still they are both Anglo-Saxon institutions dating from time immemorial, and both, as institutions, are very much alive and kicking in the 20th century. It would appear, however, that in England, the home of the privy council, that the privy vault was, comparatively speaking, very much eliminated or reduced to a state of innocuous desuetude by good sanitary methods. By the time we reach England's death rate from typhoid fever we can very well say the same of ourselves, but not until then. Why we should speak of the private well and privy vault, strikes me as rather strange so far as the adjective is concerned. If there was really such a thing as a private well, or a private vault, or a privy well, or a privy vault, in the literal sense, I should not be reading this paper to-day. In fact, we find that the well and the vault are often so close together that there is a certain ineffable unity which produces a result to the community which is, so to speak, ineluctable.

Disease Not Private Matter

The fact is that disease is not a private matter. Health is not a private matter. It is something that concerns the whole life of the community, and the neglect of which becomes a community liability, if not a scourge. One of the most serious preventable diseases we have to deal with is typhoid fever. It is a purely preventable disease, as the experience of our army on the Mexican border and in the cantonments, has shown beyond a doubt. Nevertheless, in 1916, in the 29 cities of over 200,000 population, Indianapolis was the worst sinner, in the number of reported cases per 100,000 population. Our rate in 1916 was 26.6, the highest on the list. In 1915 the rate was not so high, 12.3, and three cities, Columbus, New Orleans and Baltimore, were slightly higher, but in the five-year period, 1911-15, Indianapolis had an average rate of 20.5. Only two cities were worse, New Orleans with 20.9 and Baltimore with 23.7.

City Government Survey Report

The survey report of the city government, prepared in 1917 for the Chamber of Commerce, by the Bureau of Municipal Research of New York, has this to say on the subject: "The main causes of this condition are undoubtedly the pollution of the stream by sewage and the large number of yard privies. It is understood that a sanitary commission has been appointed to deal with the former nuisance. Two other sources of danger, namely, water and milk infection, are being eliminated by chlorination and filtration of city water and pasteurization of milk. The health department has not the power to compel householders to make sewer connections, even if sewers exist, or to prescribe a sanitary privy.

"It can, however, keep its information as to cesspools and unsanitary privies in a readily comprehensible form by carding this information and filing the cards by streets. It can also constantly agitate the question and insist that an ordinance be enacted making house connections with existing sewers compulsory upon orders from the board of health and requiring that in any future extension of sewers through built-up sections the sewer connections be made by the city and the cost be assessed upon the property owner and paid for by instalments, as other assessments are paid."

Typhoid Statistics

In 1917 there were 161 typhoid cases reported and 28 deaths; in 1918 there were 86 cases reported and 19 deaths. These statistics are not as accurate as they might be, even as to deaths for occasionally the case might develop into terminal pneumonia and death might be ascribed to this cause. It is fairly safe to say that there are ten times as

*Excerpts from a paper read before the American Water Works Association.

many cases as there are deaths, which would make 280 cases in 1917, as against 161 reported, and 190 cases in 1918 as against 86 reported.

The Privy Vault Menace

It it unnecessary for me to go into the causes of typhoid; they are perfectly well known. The existence of the disease in any strength, indicates that there are a number of human hogs about. Human filth transported from its place of deposit into the food of healthy people means typhoid.

It is estimated that there are 10,000 to 15,000 privy vaults in existence in the city of Indianapolis; many of these are on unsewered streets and the best that can be done is to see that they are screened and constructed in such a way as not to be accessible to flies, and not to be accessible to surface drainage, which causes soil pollution.

We are not the only city with such sources of public infection. St. Louis, in 1915, still had 20,000 privies, or privy sinks, 80 per cent. of which were on sewered streets. Philadelphia had 20,000, of which 10,000 had sewers accessible; Minneapolis had 17,000, Cincinnati 27,000. Toronto abolished 12,291 privy vaults in two years up to December, 1914; Philadelphia abolished 16,661 in two years. Worcester, Richmond. Buffalo and Erie report no vaults, but they are the great exceptions.

One of the objections to the elimination of these obnoxious places is the expense involved either to connect them with sewers or to place proper facilities in the interior of houses. This could be unquestionably worked out and installed just as gas or electric ranges are installed, in this case at the expense of the city, which would be repaid by the landlord over a period of months or years, as the case might be. We, in Indiana, have the Barrett Law, which furnishes us with the analogy for the carrying out of this health preventive campaign.

Deaths From Preventable Causes

About a million and a half persons die annually in the United States; probably 25 per cent. to 33 per cent. die from preventable causes. From 35,000 to 50,000 die annually of typhoid fever; from 400,000 to 500,000 are prostrated by this dread disease. Let us compare this with the figures of other countries:—

	Deaths	Sick
France	10,000	100,000
England	8,000	80,000
Germany	5,000	50,000

This comparison shows very plainly where we stand in the matter of public cleanliness. Bridgeport, in 1910, was the only American city having a death rate from typhoid of less than 5 per 100,000. Can we afford, as a nation, to permit the economic loss from sickness which runs from $1,500,000,000 to $2,000,000,000 a year, to continue? In 1908 Dr. Ditman wrote, "The cost of typhoid fever each year in sickness and death throughout America amounts to many million dollars. The sickness and death from this cause in this city and in Philadelphia, Scranton and Pittsburgh, during a single year, represent an economic loss to those cities of $3,750,000; such epidemics with their resulting losses, are startling in an age which considers itself enlightened."

Typhoid Disease of Uncivilization

Typhoid is the disease of uncivilization. As Sedgwick says, "Defective sanitation is but another name for defective civilization." The average rate from typhoid throughout the United States per 100,000 is 22. In Indiana as a whole, it is 40. The average for a ten-year period is far greater.

With 30,000 deaths per year from typhoid, the yearly loss is easily $150,000,000. It is just as stupid for us to permit this loss to continue as it is to permit our tremendous fire losses to continue, but just so long as ignorance and indifference create this disease politic, we shall continue to have it. According to Dr. Morgan, of the city board of health, the number of private wells is 308 and of privy vaults 664 within the mile square in this city (Indianapolis). You will probably be startled to ascertain the number of each, but this is based on a sanitary survey recently made and shows conclusively that we are sitting on a volcano so far as typhoid is concerned. As Lawrence Veiller, secretary of the National Housing Association, says, "How profitless is it for a city to spend vast sums of money to insure a supply of pure water to its inhabitants, and at the same time to allow barbarous privy vaults, sinks of iniquity, to drain their contents into private wells, still used by 'conservative citizens', who cling to them with startling tenacity."

When you stop to consider that during the epidemic of 1916, at the rate of $300 as an average cost of medical care per case, it cost the citizens of Indianapolis in the vicinity of $250,000. Without attempting to estimate the economic loss to industry, one can readily grasp the financial significance of further temporarizing with middle-age sanitary facilities.

Proper Ordinance Needed

This condition can be eliminated by the right kind of an ordinance, which, once backed by an enlightened public opinion, will go through without any difficulty. "There never was a reform in administration in this world," says Elihu Root, "which did not have to make its way against the strong feeling of good, honest men concerned in existing methods of administration, and who saw nothing wrong. It is no impeachment of a man's honesty, his integrity, that he thinks the methods that he is familiar with and in which he is engaged are all right. But you cannot make any improvement in this world without over-riding the satisfaction that men have in things as they are, and of which they are a contented and successful part." Mr. Root here states admirably the position of those who want to stand pat in health matters, and want to stand pat in this matter of privy vaults, because it involves a few of their dollars.

Have we not learned among other things, in this war that human lives come before dollars, that we are spiritual beings first and human beings second? We must become as interested in the conservation of human life, at least as interested as we are in the conservation of animal life, and surely in a great agricultural state like this, we do not neglect our stock. Human life seems so cheap after a great war when 7,000,000 men fell that others may live in freedom. Surely after this tremendous drain on the world's stock of humanity we can leave no stones unturned to preserve what the war has left intact, and fortunately we, in the United States, suffered almost no loss as compared to our annual loss from preventable disease. Our total deaths in this war was only twice our annual loss from typhoid.

New Spirit in Industry

In closing, let me quote from a statement of the Minneapolis Civic and Commerce Association, substituting the word Indianapolis for Minneapolis:

"A new spirit is developing in industry, a spirit of a realization that all industry suffers through the misfortune of any factor. The employer fails to prosper as his men fail to prosper. Bad housing for the workmen means bad business for the one who hires. In the light of this spirit, the primary question is not 'What can the tenant afford?' It is, 'What can Indianapolis afford?' If we are to develop in Indianapolis the highest type of civilization, if industry is to thrive permanently, if art and music are to serve their highest purpose, we must first recognize as an essential prerequisite to the realization of these high ideals, the providing of a home life for every family, rich or poor, that shall insure to them their inalienable right to sanitation, safety, ventilation, privacy, sunlight, space and beauty."

Official announcement is likely to be made at an early date of the appointment by the Dominion government of an Honorary Advisory Highway Board which will assist the Department of Railways and Canals in formulating its good roads policy for the enactment of the legislation, recently passed by parliament, appropriating $20,000,000 for federal aid for highways. Daily newspapers report that there are rumors in Ottawa that C. A. McGrath, chairman of the Canadian section of the International Joint Commission, will be a member of the board, and that Home Smith, of Toronto, and J. P. Mullarky, of Montreal, may be appointed.

PROGRESS IN WATER-TURBINE DESIGN

Excerpt from Annual Report of Canadian Electrical Association's Committee on Prime Movers. Signed by S. Svenningson (Chairman), A. H. Wilson and A. J. McDougall

DURING the four or five years period prior to the war the manufacturers of hydraulic turbines made great strides in developing units of high efficiency and simple designs. This was primarily obtained through the introduction of the high specific speed single runner units. During this period a great number of low head plants were built using single runner units of larger size than anything previously attempted. During the last four years, however, the activities in hydro-electric developments were greatly lessened and few new features in design have come out, although a certain amount of research work has been carried out the benefit of which should be realized in the near future.

Efficiencies of 92 to 93% for runners have already been obtained in several plants and we may assume that this is very near the maximum efficiency that can be expected; but, in order to obtain a maximum overall efficiency of plants, hydraulic turbine engineers are now carefully looking into the design of all passageways from headrace to tailrace. Particular attention is being paid to the design and efficiency of draft tubes for high specific speed runners. The tendency is towards the use of deeper draft tubes with the idea of making the turn from the vertical to the horizontal direction at lower velocities than was previous practice.

It is also generally realized that improvements can be made in the design of intakes, especially for low head plants.

There seems to be a difference of opinion as to the number and size of units to be installed in a projected plant; the tendency has been to look upon the water turbine as an almost fool-proof piece of machinery; consequently, plants have been equipped with as few and as large units as possible, thereby making considerable saving in first cost as well as operating expense. Considering, however, that the reliability of a unit does not only depend upon the water turbine but also on the generator and auxiliaries, some designers of power plants incline towards comparatively small units with less chance of shortage of power in case of breakdowns. The question as to size and number of wheels to be installed in a plant must, of course, also be decided upon with regard to the transmission system and importance of continuous service.

Runners

The single runner vertical shaft units for low and medium head plants have proven to be of such a success that practically all new plants under this category are now being equipped with this type of units.

Turbine manufacturers are constantly experimenting with higher specific speed runners in order to meet the demand from customers for large units operating under low heads. While a few years ago a specific speed of 100 was considered high, manufacturers claim to-day to be able to build low head units with a specific speed of 170.

Thrust Bearings

With the increase in size of large vertical water wheels and the consequent increase in weight of the rotating parts, the importance of satisfactory thrust bearings cannot be exaggerated and a great deal of progress has been made in recent years.

The General Electric Company, Schenectady, N.Y., have developed a spring-supported thrust bearing in an effort to overcome certain difficulties experienced in the operation of thrust bearings on this character of service. The main features of the spring supported thrust bearing is that it automatically adjusts itself to unequal loading due to inaccurcies in workmanship or in alignment. A distinctive feature of this bearing is that it will automatically adjust itself while in operation if there is a loss of alignment due to settling of the foundation or to other causes.

The bearing is not affected by wobbling of the shaft. The rubbing surfaces are in a bath of oil and the quantity of oil circulated from an outside source depends on the losses and the cooling conditions. Water cooling coils may be installed in the bearing housing which will reduce the amount of oil and in certain sizes of bearings at low speed, no circulation of oil from a source outside the bearing housing is required.

The salient features of the G. E. spring-supported thrust bearing are:—

A thrust collar keyed to the shaft which transmits the weight of the revolving parts to the rotating ring of the bearings. This rotating ring has a smooth rubbing surface and is so designed that a rapid circulation of oil is maintained.

There is also a stationary ring, the upper surface of which is the stationary rubbing surface of the bearing. This ring rests on springs and to insure flexibility it is made thin and has a radical saw cut through one side.

Sufficient springs are provided so that the stress is only about one half that usually used and the deflection under load is about 0.1 in.

Cooling coils are used to carry off a part of all the heat generated between the rubbing surfaces of the bearing. Centre pins hold the springs in position. An oil tube is provided which forms the inside annular wall of the oil chamber and is welded to its supporting ring. Vowel pins keep the stationary ring from revolving.

G. E. Bearings at Cedars

Two of these bearings have recently been installed in the Cedars Rapids plant of the Montreal Light, Heat & Power Consld., in connection with the last two 10,800 h.p. units, and have now been in operation for some months and have given entire satisfaction.

These bearings are designed to sustain a load of 550,000 pounds during continuous operation of the generating units at a normal speed of 55.6 r.p.m. A good grade of lubricating oil well filtered and free from water or entrained air and at a temperature not greater than 43 deg. C. maintained at a level above the sliding surfaces is used and under these conditions bearings can carry 600,000 lbs. without injury.

The cooling coils are placed within the bearing housing beneath the surface of the oil and are of such length, number and size as will keep the temperature of the oil within the bearing housing under 45 deg. C. when supplied with water at 25 deg. C. under all conditions of normal operation. The bearings are capable of operating at a maximum runaway speed of the unit, not exceeding 111.2 revolutions per minute of the shaft, for the space of one hour, and the temperature of the oil not exceeding 55 deg. C. The bearings are also capable of starting from rest and stopping as often as may be required by service conditions.

Bearings are designed to suffer no injury due to interruptions of water circulation for space of one-half hour under otherwise normal conditions or for a space of 20 min. not exceeding 50% above normal speed.

The general construction of these bearings is such as will allow the bearing in all its parts to be removed from the bearing housing without disturbing the generator or waterwheel except by supporting the turbine shaft and generator by independent means provided, and removing the thrust block keyed to the top of the shaft.

These bearings are the first ones of this size to be equipped with water cooling coils for circulation of cooling water instead of using oil circulation.

Kingsbury Bearings at Queenston

The Kingsbury thrust bearing has already been described to a great extent in many engineering periodicals and shall not again be treated in this report. It may be of interest, however, that this type of bearing has been adopted by the Hydro-Electric Power Commission of Ontario for the Westinghouse generators on the Chippawa-Queenston development. They are designed to carry a load of 900,000 lbs. at 187½ r.p.m.

Governors

No radical departure from standard designs of governers, mechanical or hydraulic, have taken place recently. The tendency has been in the past to specify quick acting governors in order to maintain a constant voltage. This tendency may lead to serious troubles, particularly where the

turbines are connected to long penstocks which are not protected by relief valves or surge tanks.

Designers are aware of this danger and considerable attention is now paid to this problem.

Troubles encountered in governor systems, such as corrosion of pipe lines and governor parts, where water is used as operating fluid, are being met by the introduction of soluable oil barium hydrate and potasium bichromate into the operating fluid.

There still seems to be a difference of opinion among designers as to the advisability of using individual governor systems or having all governors receive the operating fluid from a central pumping system. The latter system is, as a rule, the cheapest and when the necessary care is taken laying out pumps, pipe lines, etc., very satisfactory from an operating point of view.

A noticeable improvement has taken place in recent designs of water turbines with regard to accessibility, thorough lubrication and easy cleaning of turbine parts. One of the important features of the single runner vertical unit is the easy removal of gate mechanism for inspection, as well as the easy adjustment of guide vanes.

SCREEN WHEEL FOR REMOVAL OF ALGAE IN IRRIGATION CANAL*

By E. Court Eaton
Superintendent Lindsay-Strathmore Irrigation District; Formerly Assistant Irrigation Engineer, C.P.R.

A GOOD deal of trouble was experienced by the Lindsay-Strathmore Irrigation District of Lindsay, Cal., during the season of 1918 with algae or "moss" in an open lined canal. To prevent the particles of this growth from entering the distributing pipes of the system, removable screens were first placed in the canal, and these were taken out and washed with a hose as required. It was found, however, that these screens required the continued presence of a man day and night, as they needed cleaning every 15 minutes. To do away with this expense, a revolving screen wheel was designed.

Driven by Paddle Wheel

The canal has a bottom width of 6.3 ft. and a total depth of 3.5 ft. A rotary drum, made of two circular sections of 3-in. lumber was made up and suitably braced. This was covered with a galvanized screen having a ¼-in. mesh; four vanes, or paddles, were placed inside this, it being the intention to have the wheel rotated by the velocity of the water in the canal.

It was soon found, however, that this had a tendency to roll the streamers of algae under the wheel, and thus allow a large percentage to pass the wheels. Accordingly, the paddles were removed and a separate paddle-wheel built in upstream, connected by a crossed belt of cable to the screen wheel, and by this means the wheel was rotated in a direction against the flow of the water. To assist in picking up the larger particles, six rows of nails were driven into the circumference, parallel with the axis.

Washed at Every Revolution

The screen wheel is supported by, and rotates on, a length of 4-in. wrought iron pipe as a shaft, and this pipe is perforated with a row of 3 16-in. holes. One end of this pipe is connected to one of the pressure mains from the pumps, thus washing off the collection of moss at each revolution, which is caught in a trough and run to waste.

The wheel has been successful, and would be improved if built up of steel, allowing smaller clearances between the bottom and sides of the canal and the rotating wheel. A good deal of water is necessary to clean the screens, this depending, of course, on the quantity of material to be removed.

*From "Engineering and Contracting," Chicago.

COST AND LIFE OF NEW YORK STATE HIGHWAY PAVEMENTS*

ON January 1st, 1918, we had in New York State 6,912 miles of pavement, of which 5,820 miles were non-permanent types and 1,092 miles permanent types, of the latter all but 129 miles being of brick or concrete.

Water-bound Macadam.—This pavement is best adapted to the needs of light traffic, but has no place on any through route. It costs to-day about $23,000 per mile for a 16-26-ft. pavement 9 in. thick (3-in. top on 6-in. sub-base). Low construction cost has been the greatest advantage. Its greatest disadvantage now is its high cost of maintenance, which in 1917 amounted to $970 per mile. The average life of this type of pavement is seven years for a traffic of under 1,000 tons a day. Many waterbound roads have worn out in from one to three years when called upon to carry a heavier tonnage.

Bituminous Macadam Penetration Method.—This type is also adapted to light traffic generally, and is advantageous in many localities where the only stone available is non-binding. Among its disadvantages is its tendency to creep under traffic. It is slippery when wet; has a fairly high cost of maintenance—$412 per mile during 1917; and a construction cost of $28,500 per mile for a 16-26-ft. pavement 9 in. thick (3-in. top course and 6-in. sub-base bottom course). The average life of this type is two years more than that for waterbound macadam under similar traffic conditions.

The determination given for average life of the above types was made in 1917. The much heavier traffic tonnage of to-day would shorten it considerably.

Concrete.—Has the disadvantage of a glare. It has the advantage of low first cost, $31,200 per mile to-day for a 16-26-ft. pavement 6 in. average thickness. The maintenance on it in 1917 was $112 per mile. Its average life so far can only be estimated, but, judging from the condition of 5 to 9-year-old pavements of this type with which I am familiar, we can say at least 15 years.

Brick Pavements, Semi-monolithic.—This type differs from the original brick pavement in that there is no sand cushion, but the bricks are laid in a cement sand bed and grouted with cement grout to form an integral part of the pavement. This type has the advantage of developing beam strength as in concrete pavement, and eliminates the shifting of and depressions in the brick. Its cost under present conditions would be about $50,600 per mile for a 3-in. brick on a 4-in. concrete foundation. I have no maintenance figures for this type, as we have been building it only a little over a year.

Brick Pavements, Monolithic Type.—It differs from the semi-monolithic type in that the brick are set in a green concrete and grouted with a cement grout, forming an integral part of the pavement. This type develops the full beam strength, and has even greater advantages, so far as strength is concerned, than the semi-monolithic type. It is more difficult, however, to get as smooth a surface as with the semi-monolithic type.

Asphaltic Concrete.—In order to insure a nearly smooth pavement, a smooth concrete foundation should be provided. These pavements have the disadvantage of pushing under traffic from future consolidation if the aggregate is not properly sized and proportioned, or carries too much bituminous material. However, if too little bituminous material is used, the pavement becomes dry and soon disintegrates. The ideal mix is one in which the motor oil dropped from cars renews the volatile oils lost. These pavements cost about $40,000 per mile, depending upon the type, with a 2-in. top and a 5-in. concrete foundation. Their maintenance cost in 1917 was $245 per mile.

There are many patent types of pavement which come under the classification of permanent types, and which are good.

*From a paper presented before the New York Chapter of the American Society of Civil Engineers by H. E. Breed, formerly Deputy Highway Commissioner of New York State.

CANADA'S CANAL SYSTEM*

By W. A. Bowden
Chief Engineer, Department of Railways and Canals

THE through water route between Montreal, at the head of ocean navigation, and Fort William and Port Arthur, on the west shore of Lake Superior, comprises 74 miles of canal, with 48 locks and 1,155 miles of river and lake waters, or a total of 1,229 miles.

The minimum depth of water on this route is 14 feet. From Montreal to Duluth, on the south-west end of Lake Superior, the total distance is 1,354 miles, and to Chicago 1,286 miles.

Connection is made with the Canadian Pacific Railway from points west and south at Fort William and Port Arthur, six miles apart. From Fort William connection with the main transcontinental line of the Canadian Government Railways is made by the branch line originally constructed by the Grand Trunk Pacific Railway, but now leased to and operated by the Canadian Government Railways.

On this through route the approaches to the canals and the channels of the intermediate river reaches are well defined, and are lighted with gas buoys under the control of the Department of Marine and Fisheries, admitting of safe navigation in the hands of competent pilots both by day and by night. The Lachine, Soulanges, Cornwall, Welland, and Sault Ste. Marie canals are lighted throughout by electricity and electrically operated. The Farran's Point canal is lighted by acetylene gas.

Of the minor systems, the Murray, Trent, Rideau, and Ottawa River canals may be considered geographically as branches of the through east and west route. In operation, however, these canals serve a distinct traffic of more local nature. Isolated from the systems just mentioned, the navigation of the Richelieu River, from its junction with the St. Lawrence at Sorel to Lake Champlain, is effected by means of the St. Ours Lock and the Chambly Canal; while in the extreme east the St. Peter's Canal provides communication between the Bras d'Or Lakes of Cape Breton Island and the Atlantic Ocean.

*From the annual report of the Department of Railways and Canals.

SUPER-POWER PLANTS**

By L. G. Denis
Hydro-Electric Engineer, Commission of Conservation

THE recent decision to proceed with the super-power station scheme for electric supply in Great Britain, calls to our notice what should be done along these lines on a more modest scale in certain portions of Canada.

The British plan to improve the supply of electricity throughout Britain contemplates the replacement of the numerous small stations now in operation by fewer but much larger stations supplying extensive districts through high-tension transmission works. There will be a gain both in economy and fuel conservation, and, in many cases, the quality of service will be much improved. This national electric supply operates under the supervision of five commissioners appointed by the Board of Trade; these, in turn, appoint district boards, which include representatives of electric undertakings, of large consumers and of labor.

Lancashire is to be one of the first areas dealt with, the county being divided into three districts. Some of the smaller stations will probably be shut down immediately, the energy transmitted from larger existing stations being substituted. Following the building of the new super-power plants, the commissioners will eliminate the remaining small stations and also the moderate-sized plants.

A similar situation, however, does not occur in Canada, as by far the larger portion of the capacity of our hydro-electric stations is to be found in what may be called "super-power" stations; many of them are also interconnected to allow more efficient operation.

There is, however, a portion of Canada where the absence of water power makes it necessary to supply power from steam or other fuel agencies. This area, which comprises southern Saskatchewan and adjacent portions of Manitoba and Alberta, is becoming of much importance through its rapid agricultural expansion, and its future needs should be anticipated so far as possible.

As pointed out in a report on "Electric Generation and Distribution in Canada," recently pubilshed by the Commission of Conservation, adequate supply of electric energy in this section is confined to a few large centres. The smaller municipalities have installed small electric plants, which are usually very expensive to operate and only give a night service. The rates which have consequently to be charged and the limited service prevent the full benefit which should otherwise be enjoyed from the various uses of electric energy. All these small plants through concerted action could be replaced by a few large and more efficient ones, each supplying a fairly extensive district by means of electric transmission lines. The cost of production would be reduced to about one-third and a better service supplied.

The example given in the above-mentioned report illustrates the possibilities in the Estevan district. A central power plant at Estevan would supply transmission lines radiating in various directions, covering a total length of 150 miles. The estimated demand, based on the requirements of the near future, shows a total of some 600 h.p. outside of Estevan. As the lines would only carry a light load, they could be built cheaply with light conductors and at a cost possibly not exceeding $2,500 per mile. If we allow a load factor of 40 per cent., the cost of transmission would average 2½ cents per k.w.h. The cost of production in the central plant would be from 2½ cents to 3 cents per k.w.h., so that the electricity could be delivered for an average of from 5 cents to 5½ cents per k.w.h. at the various small centres supplied. With a small plant, the present cost runs as high as from 15 cents to 19 cents per k.w.h. Numerous other districts, if treated in the same way, would probably show advantageous results.

**From "Conservation," the official bulletin of the Commission of Conservation, Ottawa.

BALDWIN'S CANADIAN STEEL CORPORATION

ANNOUNCEMENT is made that the British Forgings plant at Toronto, which was recently bought by Baldwin's, Ltd., of Swansea, Wales, will be operated as Baldwin's Canadian Steel Corporation, Ltd. The new firm will be capitalized at $10,000,000, it is said, and will employ 2,300 men within a year.

E. L. Cousins, chief engineer of the Toronto Harbor Commission, who negotiated with the company on behalf of the city and the harbor commission, states that A. M. Russel, of Hugh Russel & Sons, Ltd., Montreal, was largely instrumental in persuading Baldwin's to establish a plant in Canada. Mr. Russel went to Wales for the purpose of interesting his principals, with the result that J. C. Davies, managing director of Baldwin's, Ltd., came to Canada, accompanied by D. E. Roberts, consulting engineer of the company, and the deal was consummated soon afterwards. Mr. Russel will be president of the new Canadian corporation.

Within a few months the new firm will begin the manufacture of tin plates, black sheet and galvanized sheet. The British Forgings plant, located in the Toronto Harbor Commission's eastern harbour terminal, is 127 acres in extent, with 1,600 lineal feet of 24-ft. dockage. The new company also holds an option on 79 acres of additional land. A detailed description of the British Forgings plant was published in the March 27th, 1919, issue of *The Canadian Engineer*.

DRAFTSMEN'S ASSOCIATION ORGANIZED

FOLLOWING a series of meetings attended by a number of Toronto draftsmen, an association was recently organized under the name of the Draftsmen's Association. The address of the association is given as P.O. Box 453, Toronto, but the letterhead does not state the names of the officers of the society. A circular letter, also anonymous, has been mailed to draftsmen throughout Canada. This circular, which states that it was drafted by the association and approved by the executive committee, is as follows:—

"Following a series of meetings attended by a great number of draftsmen of all branches, the above association was duly formed, and the officials elected by secret ballot on the date set above. What were the salient reasons that prompted the draftsmen of the different professions or branches connected with the arts and science of building, construction, engineering and marine to become the pioneers of such a movement?

"1.—To promote more professional etiqutte of the various branches of arts and science similar to that of the physician, lawyer, etc.

"2.—To ensure that all work be carried out by men of specific qualifications.

"3.—That the branches of arts and science shall know each other closer in relation to their work and eliminate professional jealousy.

"4.—That by means of lectures and classes to be given by advanced members of the association, a broader knowledge be imparted to the younger element of all branches.

"5.—To act habitually through the associations of architects, engineers and draftsmen and their chapters; in other words, to act as a compact, professional body, and not as individuals.

"6.—To convince the employers of the different branches that the maintenance of ethical standards is the only right road to business success.

"7.—To make the employers believe in us because we believe in ourselves.

"8.—To promote such interest and participation in public and quasi-public affairs that will show the draftsmen to be men of general ability and civic pride, and not merely self-interested individuals.

"9.—To create a more equable relation between employers and employees.

"10.—That the employers who purchase the brains of the different services financially realize the value thereof.

"11.—Last, and not least, that by inspiration and thoroughness in the training of the junior draftsmen, this association aspires to do what the societies of architects and engineers have failed to do, namely, a more sound training in every branch of the arts and science, and ensure better recognition of the draftsman as a co-ordinate to the architect or engineer."

The explosion in the grain elevator at Port Colborne, Ont., was caused through the ignition of wheat dust, states the tentative report of the commission of engineers appointed by the Dominion government to investigate the accident. It is thought that the "leg" used for loading the boats jammed, causing excessive friction between pulley and belt. When the "leg" fell, raising a cloud of dust, the latter was ignited from the heat generated by the pulley.

Announcement was made in last week's issue that Jones & Attwood, Ltd., of Stourbridge, Eng., who are the owners of the patents on the activated sludge method of sewage disposal, were transferring that department of their business to a newly-formed firm, Activated Sludge, Ltd., of Stourbridge. Later reports from England state that while the new company has been registered, final arrangements have not yet been completed, and in the meantime all activated sludge business is being handled as in the past by Jones & Attwood, Ltd.

THE ORGANIZATION OF EFFICIENT CONCRETE ROAD CONSTRUCTION GANGS*

By Halbert P. Gillette

THIS question is often asked of the man who has made an enviable financial record: "What is the secret of your success?" If he is not a man given to analyzing his methods, he is apt to reply with some generalization that is too broad to be serviceable to others, such as "Hard work is the secret," or "Strict honesty," or "Attention to details," and the like.

The fact is that there is no single "secret" of success, whether it be winning battles or building roads. Success is usually a simple result, but it is never attained by a single "open sesame." It is the outcome of the judicious application of many separate factors. So, in discussing how to organize construction gangs with which to build roads economically, we must dismiss at once the idea that there is any one way that is invariably successful in accomplishing the desired minimum cost.

"Tricks of the Trade"

On the other hand, although different organizations are needed for different conditions, there are a few general principles of organization applicable under any condition; and there are many subsidiary principles of organization applicable under more specific conditions. In addition to such principles, there is an almost limitless number of "tricks of the trade" that can be profitably applied only under very specific conditions.

To illustrate, it is a good general rule of organization that each construction gang should be composed of men of the same nationality. This broad rule may be broadened to read: Other factors being equal, the best construction gang is one composed of individuals having similar temperament and habits. Experience has taught us that this is a sound rule of very broad application. It holds as true of sewer work as of road work, of military units as of a squad of religious revivalists.

There are, however, "secrets" of organization success that are of somewhat narrower application. Thus it is a good rule to make one of a gang of shovelers the leader or pace maker, that is, a sort of "working foreman." Such a man should be more ambitious than the rest, and close mouthed enough not to state his weekly bonus to his fellows. If paid a bonus of $5 to $10 a week above the average wage, a good "working foreman" will set a pace that will decidedly increase the output of a shoveling gang. This principal of employing "working foremen" is one that was formerly more commonly applied than at present. It has lost none of its efficacy.

"Spotting" and Regulating Loads

As an example of a minor "trick of the trade," or economic method of limited application, the following is offered. Let it be the duty of one man to "spot" every load of stone (or gravel) and sand, instructing the driver exactly where to dump it. This man may also have other functions to perform, such as setting the side-boards or "rules," trimming subgrade, or what not. But even if he were to do nothing else than place the aggregates properly, he would save more than his wages. It is not uncommon to see piles of stone or gravel shoveled off the roadbed onto the shoulders, because loads of aggregate were dumped too close together. It is equally common to see loads too far apart, resulting in long hauls for wheel-barrows and the subsequent bringing in of extra wagon loads of materials under adverse hauling conditions.

Closely allied to this "trick" of having a man "spot" each load, is having a man regulate the size of loads at the point of loading. The size of wagon or truck loads may vary 5 to 10% unless it is some one's duty to watch the loading. Standard loading is highly desirable, as a little consideration will show. But by standard loading, I do not mean an unvarying size of load throughout an entire job. I mean a standard size for given hauling conditions. If the earth over which the load is hauled is hard, and if the grades

*From the "Concrete Highway Magazine."

are easy, the standard load should be large. Under more difficult hauling conditions, it should be smaller. But in every case, the standard load for given conditions should be adhered to rigorously. This can be accomplished only by making it the special duty of some one to watch the loading of wagons or trucks.

Reviewing the three examples just given, we have (1) the broad principle of selecting similar individuals for each gang; (2) the narrower principle of having a "working foreman" for shoveling gangs; and (3) the still narrower construction methods of "spotting wagons" and of "standard sizing of loads."

In this connection it may be well to point out that men of college education are apt to be unduly impressed by what are called "general principles." Let a "law of nature" be announced and most college men are prepared to kowtow; but let a "trick of the trade" or a "construction method" be announced and they may not deign to lift an eyebrow. I am convinced that this false attitude toward the humble "tricks of the trade" accounts largely for the failure of many a college engineer to make a good superintendent of construction. However, engineering colleges are rapidly improving and fewer students are being graduated under the false impression that a knowledge of "tricks of the trade" is less important than a knowledge of broad principles.

The only difference between the worth of a broad principle and of a special economic method, or "trick," lies in the number of cases to which each is applicable. Hence it may happen that it is worth more to a road-builder to know that it pays to "spot" wagon loads than to know Newton's laws of gravitation.

A manager of concrete road gangs should be acquainted not only with the general principles of scientific management but with a great many specific methods of transporting, mixing, placing and surfacing concrete. The larger his store of knowledge of methods, the more likely it is that he will select an economic combination of methods for any given job. Hence the importance of storing the mind with published methods and hints relating to road work. This seems perfectly self-evident, yet it is a fact that the majority of construction managers add very little to their knowledge except through personal observation.

Contractors Must Study Work

It also seems self-evident that gangs should be so organized that all the workmen will be kept uniformly busy. Yet it is very common to see a large percentage of time wasted because of poor co-ordination. This is attributable to the fact that the manager does not know what constitutes a fair day's work for a man engaged in each of the separate processes or duties. Thus, if the manager does not know how many cubic yards of sand a workman should load per hour into barrows, and how many cubic yards he should be able to wheel a distance of 100 ft. per hour, he cannot accurately assign the right number of sand loaders and wheelers to a mixer having a given hourly capacity of concrete.

For the most accurate studies of gang organization, it may be desirable to time every single process and every minute delay, using a stop watch for the purpose. Such great refinement is not ordinarily needed on construction work. But it is desirable to know the average hourly output of good workmen on each class of work under any given conditions. To do this, any given class of work should be analyzed into two general parts, namely (1) the parts that do not vary materially on different jobs, and (2) the parts that vary on different jobs. Thus, in hauling sand with wagons, the team time lost in loading and dumping each load is quite uniform, but the time spent in hauling depends on the length of the haul. Hence the time can be expressed as a constant number of minutes (say 10 minutes) per load plus a minute per 100 ft. of distance between the loading and the dumping points. With such a rule in his head, a manager is able to assign the proper number of teams to the hauling of sand. Similarly for wheelbarrow work, or for any other kind of hauling.

Having thus scientifically selected the proper number of men and teams for each duty, the manager should watch them carefully to ascertain whether there is any "soldiering" or unnecessarily lost time, either because too many or too few men have been assigned to a given task. If too many men have been assigned, say, to loading sand, the manager can usually ascertain the fact by watching them for half an hour. If too few men have been assigned to sand handling, the other men will be delayed, and this can be readily ascertained by observing the other men. So an experienced manager need not necessarily know the average time required to perform each operation, but, by a "cut and try" method, he can distribute his men with considerable accuracy. Nevertheless, even an experienced manager will effect a better organization of his forces if he knows what to expect of a man on each kind of work under given conditions.

I have found, as have other road builders, that the timing of each separate operation and each cause of "lost time" is one of the most effective means of improving the organization of men. Lost time is the greatest source of lost profits on road work. On most concrete road jobs the average daily progress of a mixer gang for a month is about half what it is during a day when everything runs smoothly. Extra parts and duplicate machines would do away with most of this lost time. But managers usually do not keep a detail record of all lost time and the causes. Hence they usually fail to realize the true economy of having spare parts, spare pumps, duplicate pipe lines, etc. For the same reason, they usually fail to realize that it pays to have spare men—men able to fill a gap or ready to attend to a breakdown or to shift a plant with expedition. A small emergency gang of "Jacks of all trades" will usually earn their wages many times over by reducing delays from breakdowns, plant shifting, short-handed crews, etc.

Keep a Note-Book

The average workman likes to do only one class of work. If his job is to finish a concrete surface, he resents being required to load a wheelbarrow. This is easy to understand where a skilled man is required to do unskilled work. Why a common laborer should resent being shifted from one class of unskilled work to another class is not so clear, but it is a fact. A wheelbarrow man dislikes turning his hand to pick and shovel work, for example. But there are a few men who seem to enjoy frequent changes, and will gladly do anything from grubbing roots to shoeing a horse, provided they are not kept at one thing very long. This is the type of man for an emergency gang. Every large road job should have such a gang.

In a brief article on a big subject it is impracticable to do more than throw out a few suggestions. Of the few here offered, there is one, however, that will prove profitable to every manager of road gangs. It is this: Keep a note book in which you enter a memorandum of every "trick of the trade" that you see, hear, or read. Number each of these "hints" serially. Read them over at intervals. You will ultimately have nearly every one of several hundred "hints" committed to memory. And as your stock of memorized "hints" grows, you will find it progressively easier to remember new "hints." Most men make the mistake of regarding the brain as a store house of limited capacity for memorized facts. Its capacity is practically limitless; and, curiously enough, the greater the number of facts of a given class that a man memorizes, the stronger does his memory grow for facts of that class. College trained engineers are particularly prone to avoid memorizing details. They argue that they need remember only general principles and that they can look up published details when necessary. In practice, however, they seldom look up published details in a thorough-going manner, partly because they haven't the sources of reference at hand, and partly because published indexes are wholly unsatisfactory for the purpose of finding such details.

In reading biographies and sketches of famous men, it is worth noting that such men are so frequently credited with having an astonishing command of memorized data relating to their specialty. James J. Hill, "the empire builder," had a memory for details of railway operating and construction costs that was amazing. He was a genius as an organizer and promoter. Certainly, his feats of memory were not merely incidental to his success, but, in large measure, accounted for it. If we cannot all be prodigies like Jim Hill, at least we can profit by using his methods.

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CONSULTING ENGINEERING ETHICS

IS it ethical for consulting engineers to quote less than 5% (of the cost of the work) for plans, specifications and supervision of erection of buildings, bridges, power plants or any other engineering undertakings? and what, if anything, should be supplied for that amount, other than the plans, specifications and personal supervision?

These questions are being actively debated among the consulting engineers of Toronto, due to recent keen competition for appointment in connection with an important bridge. One firm offered to do the work for 4%; all the other engineers asked 5%, but after their letters had been read in council meeting, and it was published that an offer of 4% had been received, one of the engineers who had bid 5%, reduced his figure to 4%, and subsequently one other 4% offer was received from a firm that had not previously tendered its services in formal manner. The work was awarded to the engineer who cut his price from 5% to 4% after he saw that another engineer had bid 4%.

Which of these two engineers, if either of them, was guilty of unethical conduct?

The man whose original bid was 4% states that 4% is his regular fee for certain classes of work, and that no engineer should have altered his price after it had been tendered. He says that he considered his services on such work worth 4%; and that if another engineer considered his own services worth 5%, he should not have entered into a price-cutting competition, but should have allowed the owners of the proposed bridge to determine whether the one man's services would be worth more than the other's services.

This man, therefore, thinks that the "cutting" from 5% to 4% was unethical, but that he was fully justified in quoting 4%. On the other hand, the engineer who "cut" is of the opinion that he was justified in so doing in order to meet unethical competition; in other words, that it was not ethical for any engineer or engineering firm to quote less than 5% at any time for plans, specifications and supervision.

Webster defines ethics, as applied to professions, as follows: "Any body of principles or rules concerning moral obligation, whether true or false, that is intended to regulate practise in any particular sphere of activity."

Are there any "principles or rules" that were violated by either of these engineers? The code of ethics of the Engineering Institute of Canada contains no reference to fees or price-cutting. The code of ethics of the American Society of Civil Engineers says: "It shall be considered unprofessional and inconsistent with honorable and dignified bearing for any member . . . to compete with another engineer for employment on the basis of professional charges, by reducing his usual charges and in this manner attempting to underbid after being informed of the charges named by another." The code of ethics of the American Institute of Consulting Engineers contains a clause almost identical to that in the A.S.C.E. code.

Obviously, however, there was no intention of *underbidding* on the part of the engineer who cut his price, but merely of *meeting* the other man's lower bid. The clause quoted above does not seem to prohibit such a reduction. It would, however, prohibit a bid of 4% if a firm's regular fee were 5% and if the reduction were made knowing that another engineer had quoted 5%. In this case, the engineer whose original bid was 4% states that 4% is his regular price on work of that amount and character. Moreover, his bid was the first one received by the owners and antedated all others by at least four days.

The only civil or consulting engineering society that has adopted a schedule of fees is the American Institute of Consulting Engineers, which stipulates 5% or more for preliminary examinations, surveys, plans and specifications, final working drawings, and consultation and general advice during construction. This is much less than the two Canadian engineers above referred to, offered to do for the same or smaller percentage. The firm that originally bid 4% offered "to place a resident engineer experienced in concrete bridge work on the job and do all necessary testing of materials entering into the construction of the bridge. In addition to the above, this fee would include the regular supervision of the work by members of this firm and preparation of monthly estimates, etc."

The engineer who reduced his bid from 5% to 4%, and who was appointed, agreed to "supervise, either by himself or by skillful, qualified persons that he may substitute, the erection and construction of the said bridge by the contractors and all work that may be incidental and necessary to properly carry out the work required for the completion, construction and erection of the said bridge . . . and that he will make proper and sufficient plans, specifications and estimates and inspections."

Toronto consulting engineers are therefore debating the advisability of adoption, by the Engineering Institute of Canada, of a schedule of minimum fees, but the majority are opposed to such action until after the American Society of Civil Engineers has adopted a similar schedule, fearing that American engineers may quote lower rates and take much work away from the Canadian engineers. Should the Engineering Institute be successful obtaining legislation closing the profession in Canada, the Canadian engineers could successfully establish a schedule regardless of what American engineers might charge; because then, in order to do work in Canada, the American engineers would have to belong to the Engineering Institute and consequently would be amenable to its regulations regarding fees in Canada.

There are times when an engineer might desire for personal reasons to become associated with some big job almost regardless of remuneration. To be forced to charge as much as men who were not actuated by the same motives, but who were bidding on the work as a purely commercial proposition, might then seem to him to be a hardship and a violation of his personal liberty. But we have all learned during the past few years that one's purely personal rights

matter but little when they are in conflict with the welfare of society as a whole, and there is no doubt but that a minimum fee, strictly observed, would certainly be beneficial to engineering as a profession and to the entire community of engineers.

Another point upon which there has been discussion, is the interpretation of the words "usual charges" in the American Society's code. What determines "his usual charges?" Must he publish or announce a personal schedule of fees? If so, could he ever lower those fees? Suppose that two engineers are being considered for certain work. Both have published schedules calling for 5%. If one of them were to submit a tender of 4%, would he not be cutting with real intention of underbidding the other man, even though the other engineer had not yet quoted on that particular work?

Moreover, just what services should a consulting engineer perform for any fixed percentage that might be adopted? The American Institute of Consulting Engineers requires its members to charge at least 10% when, in addition to preparing all the plans and specifications, they are called upon to test materials, to inspect the work and to be responsible for the organization, management and completion of the construction.

DEATH OF ANDREW CARNEGIE

ANDREW CARNEGIE'S death, August 11th, at Lenox, Mass., brought to a close a career which greatly advanced all the engineering arts and sciences. By the introduction into the United States of the Bessemer process for the production of steel, and by the establishment and development of steel plants which became the greatest in the world, he made available for engineers the most useful modern material for engineering construction.

In the successful conduct of many industrial enterprises, he amassed great wealth, the possession of which he came to regard with deep seriousness as a public trusteeship. While yet in full possession of his faculties, he devoted himself to the distribution of large portions of his fortune to projects for the benefit of mankind.

Mr. Carnegie distributed his wealth not only in many directions, but also with the exercise of great wisdom based on careful investigation. His munificence provided large funds for the building of homes for engineering societies, a number of which had elected him as an honorary member.

PRODUCTION OF COAL IN CANADA

(Continued from page 238)

ports, but in 1918 the imports of coal increased without precedent, while domestic coal outputs are declining with no immediate prospect of manifesting an opposite tendency.

It appears equally desirable and feasible that Canadian coal producers should strive to lessen the recently developed inequality in the ratio of imported coal to coal mined in Canada. Admitted that a certain tonnage of anthracite coal is probably required for domestic use because of its greater cleanliness, there is yet a large market for bituminous coal in Canada that is being filled to-day from United States sources.

Apart from the fact that raw materials obtained from outside sources provide employment in that outside source and not in the country where they are used—at least not in the same proportion—there is the further consideration that we are to-day paying for imports with a depreciated currency.

In a lecture recently delivered to the staff of Barclay's Bank, in London, Prof. Nicholson says with reference to conditions in Great Britain:—

"We are suffering in the first place from over-importation. During the war a great part of this over-importation was of the greatest national benefit. The imports from America were necessary for the conduct of the war. But an increasing part of the aggregate money value of these imports was due to the inflation of the currency and the associated rise in prices. This part was not a blessing—quite the contrary."

While a wholesale application of Prof. Nicholson's statement is not justified, yet in relation to the coal consumption of Canada, the statement is one of fitting exactitude. In brief, we are importing altogether too much coal and we are purchasing it at an increasing disadvantage.

PERSONALS

D. A. R. McCANNELL, who was recently appointed city engineer of Regina, Sask., was born in 1890, in Bruce County, Ont. His parents moved to Regina in 1893, his father being one of the first settlers who located there in 1882, before the municipality of Regina was formed. Mr. McCannell acquired his public and high school education in Regina, subsequently graduating in civil engineering at Queen's University. Commencing practice as a rodman with the engineering staff of the city of Regina in the summer of 1911, he was engaged on pavement construction until 1915, when he was appointed assistant to the city engineer. This position he held until 1917, when he became acting city engineer, and recently the city council decided to drop the word "acting" from his title.

M. L. CANTELL, of St. Boniface, Man., who is on the engineering staff of the Manitoba government, has been elected a member of the Royal Society of London, Eng.

J. LEBLANC has been appointed by the city commissioners of Montreal, as supervising engineer in charge of that city's contract work, in place of W. Matheson, resigned.

GORDON KRIBS, assistant engineer on the staff of the Hydro-Electric Power Commission of Ontario, has resigned in order to accept a position as manager of the Hespeler Manufacturing Co., Hespeler, Ont. Mr. Kribs is a graduate of the University of Toronto, Faculty of Applied Science and Engineering, class of 1905. For several years Mr. Kribs was in Texas as engineer for the Texas Power & Light Co.

ARTHUR H. BLANCHARD, consulting highway engineer, New York City, who is well known among Canadian engineers, has been appointed professor of highway engineering at the University of Michigan, Ann Harbor, Mich., the appointment to be effective commencing September 15th. This is a new chair at the University of Michigan, having been created at the last meeting of the board of regents. In addition to his consulting practice, Prof. Blanchard has been associated for some years past with the highway engineering department of Columbia University. He has given numerous lectures to Canadian audiences on various phases of highway work. Prof. Blanchard is best known as the chief editor of the "American Highway Engineer's Handbook." He is the author also of several other well-known books on highway engineering.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand or proposed, contracts awarded, changes in staffs, etc.

ADDITIONAL TENDERS PENDING

Further information may be had from the issues of *The Canadian Engineer*, to which reference is made.

PLACE OF WORK	TENDERS CLOSE	ISSUE OF	PAGE
Alderson, Alta., school	Aug. 21.	Aug. 14.	44
Bridgeville, N.S., school	Aug. 30.	July 31.	41
Halifax, N.S., transit sheds, Nos. 21 and 22	Aug. 23.	Aug. 14	46
Halifax, N.S., schools	Aug. 30.	July 31.	41
Oshawa, Ont., warehouse	Aug. 22.	Aug. 14.	46
Ottawa, Ont., pumps, engines, etc.	Aug. 30.	July 31.	44
Parkside, Sask., school	Aug. 22.	Aug. 14.	46
Peterborough, Ont., public school	Sept. 1.	Aug. 7.	48
Pointe Pizeau, Que., repairs to wharf	Aug. 28.	Aug. 14.	48
Saskatoon, Sask., turbo-generator	Sept. 23.	July 24.	44
Ste. Martine, Chateauguay, Que., pavement	Aug. 30.	Aug. 14.	42
Sydney, N.S., church	Aug. 25.	Aug. 14.	46
Toronto, Ont., additions to school	Aug. 27.	Aug. 7.	48
Webbwood, Ont., concrete walks	Aug. 23.	Aug. 14.	42
Winnipeg, Man., water recorder	Sept. 1.	July 31.	46
Toronto, Ont., addition to school, Keele	Aug. 27.	Aug. 14.	46
Toronto, Ont., addition to school, Earl Grey	Aug. 27.	Aug. 14.	46
Toronto, Ont., addition to school, Duke of Connaught	Aug. 27.	Aug. 14.	46
Toronto, Ont., 200,000 railway ties	Aug. 25.	Aug. 14.	48
Toronto, Ont., 1,375,000 railway ties	Aug. 25.	July 31.	46
Toronto, Ont., 1,400,000 railway ties	Aug. 25.	Aug. 7.	50
Toronto, Ont., 3,525,000 railway ties	Aug. 25.	Aug. 7.	50

BRIDGES, ROADS AND STREETS

Amherstburg, Ont.—Tenders will be received by the town council, until 8 p.m., August 25th, for a concrete pavement on Murray and Dalhousie Sts. W. A. McCormick, town clerk, Box 161, Amherstburg.

Amherstburg, Ont.—Tenders will be received by W. A. McCormick, town clerk, Box 161, Amherstburg, up to 8 o'clock p.m., Monday, August 25th, 1919, for a concrete pavement on Murray and Dalhouise Sts., according to plans and specifications which may be seen in the office of the town clerk.

Brantford, Ont.—Construction has commenced on the Brantford-Hamilton highway. Curves are being eliminated as far as possible and the road widened. Pavement to be laid, bitumin. Estimated expenditure for 1919, $100,000.

Brantford, Ont.—Contract has been awarded by the city council, for construction of asphalt concrete pavements on Chatham and George St., $2.00 per sq. yd., and on Dufferin Ave., $1.85 per sq. yd. Contractor, Standard Paving Co., Ottawa.

Brantford, Ont.—Scarfe and Co., contemplates extensions to their varnish factory.

Brantford, Ont.—The highway between Hamilton and Brantford will be constructed on macadam specifications similar to such roads in England, etc. Hon. F. G. Macdairmid, minister of public works, Ontario.

Brockville, Ont.—The town council contemplate paving Pearl St., estimate of cost, $44,092, and Pine St., estimate of cost, $12,094. W. A. Lewis, mayor.

Cobourg, Ont.—Contract awarded to M. Jex and Co. for the construction of a new curling rink for the Waverly Curling Club. Work has commenced.

Creston, B.C.—Contract has been awarded by the department of public works to G. Hunt, Kitchener, B.C., for construction of 1.5 miles of new road between Goatfell and Creston. Wm. Ramsay, district engineer.

Edmonton, Alta.—Sidewalks planned include both sides of 107th St., from Jasper Ave. to 100th Ave. Cinder walks to be built on the south side, 2 mls., west end, 2 mls., east end, 2 mls. Cost, $7,000. City engineer Haddow.

Edmonton, Alta.—The city council will consider construction of a new concrete sidewalk on Grierson St. A. W. Haddow, city engineer.

Fort William, Ont.—City council will construct sidewalks on Vicker's and Harold Sts.

Fort William, Ont.—Tenders will be received until August 30th, by the municipality of Paipoonge, for construction of a timber bridge and a culvert. W. A. Dyke, clerk, 115 St. May St., Fort William.

Fort William, Ont.—Tenders will be received until noon, August 29th, by the city engineer, for construction of approximately 1,550 lin. ft. of curb and gutter, 4,300 sq. yds. asphalt, asphalt concrete, or bitulithic pavement on 6-in. concrete base. C. B. Symes, city engineer. (Official advertisement in this issue).

Galt, Ont.—The board of works will undertake temporary repairs to the Main St. bridge this fall. It is expected that a new single span bridge will be constructed in the spring.

Golden, B.C.—Tenders will be received until noon, August 25th, by the department of public works, Victoria, for construction of a bridge over the Blaeberry river. Plans, etc., at offices of assistant district engineer, Golden, B.C., and district engineer's office, Vancouver. A. E. Foreman, chief engineer, Victoria, B.C.

Guelph, Ont.—The International Malleable Iron Co., will erect a new reinforced concrete and brick factory extension. Estimated cost $33,000. W. A. Maloney, architect.

Halifax, N.S.—Tenders will be received until noon, August 27th, by the C.N. Ry., for construction of dock marginal and other paved and macadamized roads and streets at the Halifax Ocean Terminals. Plans, etc., at offices of chief engineer, Moncton, N.B.; superintending engineer, Halifax Ocean Terminals; division engineer, C.N. Ry. Tunnel Station, Montreal. F. P. Brady, general manager, Montreal, Que.

Hamilton, Ont.—An experimental pavement is being laid on MacNab St., between Main and Jackson Sts. If successful, similar pavements may be laid on steep grades near the mountain. E. R. Gray, city engineer.

Hamilton, Ont.—Bulk and separate tenders will be received by R. L. Foster, secretary of the board of education, up to 5 p.m., Monday, August 25th, for the erection of a 12-room school on Hunter St. W. Plans and specifications may be received at the office of F. W. Warren, architect, Bank of Hamilton Building.

Hamilton, Ont.—By-law has been passed authorizing completion of sidewalk on East 32nd St.

Hamilton, Ont.—Lord and Greenhood have purchased the Royal hotel and will construct an additional story.

Islington, Ont.—The Etobicoke township council will widen the roadway to 66 ft., from Weston to the border of Peel county, for which a strip of land has been purchased by the York county highways commission.

Kingston, Ont.—The board of works has sanctioned the street repairing. Additional expenditure, $3,000. Alderman Graham.

Kitchener, Ont.—Part of the plant of the Canadian Consolidated Felt Co. was completely destroyed recently by an explosion.

Kitchener, Ont.—Tenders addressed to J. I. Fletcher, Hannon R.R. 1, Ont., will be received up to August 28th, 1919, for work and materials required in the erection and completion of a soldiers' memorial hall for the board of trustees, Binbrook, Ont. Plans and specifications may be seen at the office of J. A. Armes, architect, 183 Bold St., Hamilton, Ont.

Kitchener, Ont.—The initial steps have been taken in the construction of a concrete roadbed on the main road leading from St. Jacobs to Elmira for a distance of three miles. It is expected that this stretch of roadway will form a portion of the provincial highway which has been designated from Elmira to Hamilton.

Londesboro, Ont.—Contract for material and construction of a memorial hall here has been let to Cockerline, Floody and Griffiths, Blyth, Ont.

Levis, Que.—The Levis county council passed a resolution requesting the government to open a vehicular roadway upon the Quebec bridge.

London, Ont.—The city council will receive a report from the works department on extensive repairs required to bridges at Ridout St., Chelsea Green, Dundas St. and Blackfriars. H. A. Brazier, city engineer.

Lundbreck, B.C.—Construction has commenced on the federal highway, between Lundbreck and the Crow's Nest Pass. Construction foreman, F. H. Robins.

Macgregor, Man.—Tenders will be received until noon, August 23rd, by the North Norfolk municipal council, for construction of three bridges,—E. Section 5-11-11 west, E. Section 18-12-12 west, E. Section 33-10-9 west. F. E. Lewin, secretary-treasurer, Macgregor, Man.

Moncton, N.B.—Tenders addressed to C. B. Brown, chief engineer, Canadian National Rys., Moncton, N.B., will be received up to 12 o'clock noon, Wednesday, August 27th, 1919, for the construction of docks, marginal and other paved and macadamized roads and streets at the above-mentioned location. Plans and specifications may be seen at the offices of the following: Chief engineer, eastern lines, Moncton, N.B.; superintendent engineer, Halifax ocean terminals, Halifax, N.S.; division engineer, C.N. tunnel station, Lagauchetiere St., Montreal, P.Q. Tenders for alternative propositions will be considerd if received from bona fide paving contractors, provided such alternative tenders are accompanied by complete specifications.

Montreal, Que.—It is said that the public works department, city hall, are preparing to repair the streets, on which over 20 gangs of men will be employed.

Montreal, Que.—Tenders will be received until 12 o'clock noon, August 28th, by the department of railways and canals, Ottawa, for repairs to roadway on the north embankment of the Soulanges canal. Plans, etc., at the offices of the chief engineer, Ottawa, and superintending engineer, New Birks building, Montreal. J. W. Pugsley, secretary.

Morrisburg, Ont.—Handley-Page, Ltd., has secured a Canadian charter and will probably construct factories, etc., with head offices at Morrisburg.

New Westminster, B.C.—Contract has been let to D. Philpot for the construction of the Whonnock Creek bridge at $1,590.

Oshawa, Ont.—Tenders will be received by the town council, until 5 p.m., August 28th, for construction of 17,000 sq. yds. concrete pavement and 10,000 lin. ft. concrete curb. W. G. Worden, town engineer. (Official advertisement in this issue).

Ottawa, Ont.—A commission, consisting of C. A. Magrath, Ottawa; J. P Mullarkey, Montreal, and R. Home Smith, Toronto, has been appointed to act with the minister of railways in an advisory capacity in carrying out the good roads policy.

Ottawa, Ont.—A conference will be held in Ottawa by the provincial highway commissioners to decide on the matter in which the federal grant of $20,000,000 for good roads will be decided.

Ottawa, Ont.—Tenders will be received until 3 p.m., August 26th, by the works department for construction of the following pavements: Booth St., from Somerset St. to the G.T. Ry.; St. Patrick St., from Sussex St. to MacKenzie Ave.; Murray St., from Cumberland St. to King Edward Ave.; Goulburn Ave., from Somerset St. to Osgoode. A. F. Macallum, commissioner.

Penticton, B.C.—The Kettle Valley Railway Co. has provisionally agreed to erect a warehouse for the United Seed Growers.

Regina, Sask.—A committee of the Regina Automobile Club will request the government to construct a concrete highway from Regina to Moose Jaw, 50 miles. Estimated cost, approximately $40,000 per mile.

Regina, Sask.—Contract awarded for paving Dewdney St. and spur track crossing with sheet asphalt, to the Crown Paving Co., Calgary, previously reported in this column page, amounted to $34,595.86, of which, $21,595.20 was for paving Dewdney St. Rejected tenders, Bitulithic Paving & Contracting Co., track crossings, $16,565.09, Dewdney St., $30,400.38. Crown Paving Co., asphaltic concrete, track crossings, $12,893.70, Dewdney St., $20,604.60. City engineer, track crossings, $10,480.58, Dewdney St., $22,268.00. D. A. R. McCannel, city engineer.

Ridgeway, Ont.—The construction of a concrete roadway through the village, for which contract was awarded, $22,000, has been vetoed by the deputy minister of the highway department on the grounds that inexpensive repairs

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TOWNSHIP OF YORK

CONSTRUCTION OF WATER MAINS

Sealed tenders, plainly marked as to contents, will be received by the undersigned engineer for the Municipal Corporation of the Township of York, up to 12 o'clock **noon**, Saturday, September 6th, 1919, for the construction of 6-inch cast-iron water mains in the following streets in the Township of York:—

1. Amherst Ave., Jesmond Ave., Ashbury Ave., Roach Ave., Humewood Ave., about 5,214 ft.
2. Craydon Ave., Ray Ave., Rutherford Ave., Victoria Blvd., Eglinton Ave., Brownhill Ave., Barr Ave., Elora Ave., about 5,066 ft.
3. Cliff St., Bushey Ave., Jasper Ave., Langden Ave., Orla Ave., Chryessa Ave., Gray Ave., Outlook Ave., Humber Crest Blvd., about 6,139 ft.
4. Lauder Ave., about 3,200 ft.
5. Mitchell Ave., about 1,136 ft.
6. Northland Ave., Lapp St., Spears St., McCormack St., about 3,803 ft.
7. Northcliffe Blvd. North, Lavinia Ave., Runnymede Rd., Ostend Ave., about 3,043 ft.

Plans and specifications and all necessary information may be obtained at the office of the Engineer, Frank Barber, 40 Jarvis St., Toronto.

The lowest or any tender will not necessarily be accepted.

FRANK BARBER,
Engineer.

Toronto, August 18th, 1919. 331

to the present road would have been sufficient while so many other roads in the province were in worse condition.

Sandwich, Ont.—Tenders will be received by the town council until 8 p.m., August 25th, for construction of the following:—Silex walks, both sides of Indian Rd., from London to Victoria Sts.; on the s.w. side of the Huron line from London St. to the southerly end of lot 1, plan 54; both sides of Randolph Ave., Wyandotte St. to Craig St.; both sides Rankin Ave., north line of lots 488 and 489 to Craig St.; southside Wyandotte St., from the easterly town limits to California Ave.; both sides Brock St., Baby St. to Bloomfield Rd.; south side of St. Joseph St., Peter St., to Bloomfield Rd.; east side of Peter St., St. Joseph St., to St. Antoine St.; west side Baby St., Chippewa St., to St. Antoine St. Water mains on Randolph Ave., from Wyandotte St. to Craig; Rankin Ave., from north limits to lots 488 and 489 to Craig St.; Wyandotte St., from Randolph to Rankin; Indian Rd., from London to Victoria St.; Peter St., from Huron line to Pajot Lane, all with ¾-in. lead service pipes to lot lines. Engineers, McColl & Fletcher, Windsor. E. R. North, clerk, Sandwich.

Sandwich, Ont.—The council has decided to widen Sandwich St. at the corner of Detroit St., also to construct sidewalks on several streets, for which tenders are called.

Sarnia, Ont.—The proposed Roosevelt memorial road, which is being designed to connect Portland, Oregon, and Portland, Maine, will pass through Sarnia, London and Hamilton. John Bridge, Chamber of Commerce, London.

St John, N.B.—Contract awarded to Ring & Irons for a concrete sidewalk to be erected on Main St., Fairville, between North St. and Barnhill's Corner. Contract price, $2.38 per yard.

St. Adolphe, Man.—Tenders will be received by the municipal council until 11 a.m., September 2nd, for construction of three reinforced concrete culverts and two miles of roads. C. Gauthier, clerk.

St. Francois Xavier, Man.—Grading will soon be commenced on 12 miles of highway through the municipality. Estimated cost, $24,000.

St. Telesphore, Que.—Contracts have been awarded by the Levis Rd. Commission, to George Therrier, Levis, Que., for cement pavement at St. David de L'Auberiviere, and a steel bridge over the Scie River. Arthur Pigeon, secretary.

Stonewall, Man.—Tenders will be received until August 23rd, by the municipality of Rockwood, Man., for construction of a reinforced concrete bridge, 25 ft. span, N. 7-17-3 E., for double 3 ft. by 5 ft. culverts at N. 12-14-1 E., through 26-13-1 E. and N.E., 24-16-2 E. V. W. McFarlane, secretary-treasurer.

Stratford, Ont.—City Council intends to construct a number of concrete sidewalks. R. R. Long, city clerk.

Toronto, Ont.—A foot-bridge will probably be erected over the railway tracks and the Don River in Riverdale Park.

Toronto, Ont.—Contracts have been awarded by the city council for construction of roads as follows:—Elm St., Yonge to Chestnut St., $18,430, works department; Front St., York to Simcoe St., $15,073, works department; Grosvenor St., Yonge to Queen's Park, $19,533, works department; Silverthorne Ave., $28,062, Godson Contracting Co.; Silver Birch Ave., $15,734, Asphaltic Paving Co. R. C. Harris, commissioner of works.

Toronto, Ont.—It is expected that the construction of the new steel mills of Baldwin, Ltd., Swansea, Wales, will be under way in September or October. The location is the former British Forgings plant on Harbor Commission property.

Toronto, Ont.—Tenders will be received until noon, September 2nd, by the board of control for the following pavements: Asphalt—Davenport Rd., from E.S.L., Ford St. to Weston Rd.; Northcliffe Blvd., from St. Clair Ave. to north city limit. Bitulithic—Kennedy Ave., from Bloor St. to Colbeck St.; Skipper Ave., from Jones Ave. to Donlands Ave. Brick block—Pine Cres., from 128 ft. 4 in. west of W.S., McLean Ave., to 200 ft. west of Balsam Ave. Concrete—Cuthbert Cres., from Belsize Dr. to Manor Rd.; St. Clements Ave., from Yonge St. to Duplex Ave. Track allowance—Broadview Ave., from Queen St. to Danforth Ave. Grading—Morton Rd., from Oakcrest Ave. to Danforth Ave. T. L. Church, chairman.

Toronto, Ont.—The Bloor St.—Danforth Viaduct roadway will probably be completed by the end of August. R. C. Harris, works commissioner.

Toronto, Ont.—The Toronto Housing Co. has received a permit for the erection of 32 pairs of semi-detached brick veneer and stucco dwellings on Webb Ave., near Runnymede Rd. Estimated cost, $188,900.

Toronto, Ont.—Work will be commenced on the filling of the Gerrard St. hollow immediately after the closing of the Exhibition. R. C. Harris, works commissioner.

Trail, B.C.—The city council has decided to construct concrete sidewalks on Bay and Cedar Ave., and Spokane St. Estimated cost, $9,190. Wm. E. B. Monypenny, city clerk.

Vancouver, B.C.—The school board awarded the contract for building the new Kitsilano high school to Peter Tardiff and Co., for $17,911.25.

Vancouver, B.C.—An alternative route to the Hope-Princeton highway has been suggested by Gerald Kent, civil engineer, Vancouver. This proposed route would mean the construction of only 40 miles of new roadway situated between Whytecliffe and Squamish, along Howe Sound, and a few connecting links between Squamish and Lillooet.

Victoria, B.C.—The Princeton board of trade has requested the city council to endorse provincial highway construction through Princeton and Hope to Alberta, via the Crow's Nest Pass route.

Virden, Man.—Tenders will be received until 5 p.m., August 27th, by the municipal council, for construction of a reinforced concrete bridge over Gopher Creek, Seventh Ave., Virden. Wm. Whiteford, secretary-treasurer.

Waterloo, Ont.—The Waterloo county council is requesting co-operation from councils of other municipalities to connect with border counties by a concrete highway passing from Wentworth county line to Galt, Preston and Kitchener, and from Waterloo to St. Jacobs, Elmira and Flordale to the Wellington county line.

Welland, Ont.—The new concrete road being constructed by the department of railways and canals, between Port Colborne and Welland, is being widened from 9 ft. to 14 ft.

Windsor, Ont.—The high level bridge between Windsor and Detroit, Mich., proposed as an international war memorial (recently reported in this column page), would have a clearance of 120 ft., and a single span, length 2,500 ft. Dr. J. A. L. Waddell.

Winnipeg, Man.—The works committee has recommended establishment of a 32-ft. concrete safety island at Smith St. and Portage Ave. Estimated cost to equip the roads of the entire city with these islands, $8,400.

Winnipeg, Man.—The following contracts have been awarded by the good roads board totalling $59,625 in the following municipalities:—Oakland, roads and bridge, to S. Karper, Winnipeg, $5,019. Lansdowne, concrete bridge, to A. Scobie, Winnipeg, $3,864. Glenwood, 29 miles grading, to K. Murcheson, Souris, $31,140. Pipestone, bridge, to W. T. Mauser, Virden, $4,751. Woodworth, bridge, to J. Kelly, Winnipeg, $5,494. Birtle, Portage la Prairie and Morden, bridges, to La Cour & Schoeler, Winnipeg, $3,100, $2,918 and $3,339.

York Tp., Ont.—The township council instructed Engineer Frank Barber to prepare plans for a bridge on Buson Rd.

York Tp., Ont.—The township council will immediately lay a new sidewalk on the north side of St. John's Rd., from Runnymede to Jane St.

York Tp., Ont.—Township council decided to proceed with the extension of Woodville Ave.

York Tp., Ont.—Township council accepted plans for a 24-foot pavement on Pinewood Rd., from High St. to the city limits, and a 28-foot pavement, with a concrete gutter, on Glenholme Ave., from the present pavement to Rogers Rd. Council will probably also construct a number of sidewalks. Engineer, Frank Barber.

York Tp., Ont.—Township engineer Frank Barber was instructed by the council to prepare plans for a bridge on Buson Rd.

Barrett Specification Roof on the Geo. Pattinson Co. buildings, Preston, Ont. General Contractors—P. H. Secord & Sons, Brantford, Ont. Roofer—Brown Jarvis Roofing Co., Brantford, Ont. Architect—J. Micklen, Preston, Ont.

These Buildings all have Roofs that can be *forgotten* for 20 Years!

THE owner of each of these buildings has received from us a Surety Bond, issued by one of the largest surety companies in the world, *guaranteeing their roofs against leaks, wear, and maintenance cost for twenty years.*

Of course, Barrett Specification Roofs do not need this guaranty to make them wear and last. The fact that most of the important buildings in Canada have the Barrett Specification type of roof proves that.

Barrett Specification Roof on the plant of the Pollock Manufacturing Co., Limited, Kitchener, Ont. Architect—C. Cowan. Roofer—Brown Jarvis Roofing Co., Brantford Ont.

Barrett Specification Roof on Athelma Apartments, Toronto, Ont. Roofer—Reggin & Spence, Toronto.

We issue this Surety Bond Guaranty merely as a means of impressing upon you our confidence in Barrett Specification Roofs. The guaranty is your assurance that you have on your building a roof that will need no attention and will give you complete, unqualified satisfaction for twenty years at least, *and probably much longer.* All you need to do to have such a roof is to incorporate in your building specification this sentence: "The roof shall be laid according to The Barrett Specification dated May 1, 1916, and the contractors shall obtain for us the Barrett 20-Year Guaranty Bond."

There is no charge for this Bond. It is obtainable on any roof of fifty squares or larger in towns of 25,000 or more, and in smaller places where our Inspection Service is available.

It will be issued to reputable roofing contractors, approved by us, who use the materials specified and who will agree to examination and approval by our inspectors. Barrett Specification Roofs cost less per year of service than any other kind; they take the base rate of fire insurance; in fact, any way you look at it, a Barrett Specification Roof is the best roofing made for permanent buildings.

A copy of the Barrett 20-Year Specification, with roofing diagrams, sent free on request.

The Barrett Company LIMITED

MONTREAL TORONTO WINNIPEG VANCOUVER
ST. JOHN, N.B. HALIFAX N.S. SYDNEY, N.S.

York Township, Ont.—Tenders will be received until noon, September 6th, by the township engineer, for construction of concrete sidewalks on Bernice Crescent, Dennis, Gamble, McRoberts, Poulton and Torrens Ave., also for tarvia pavement on concrete base on Westmount Ave. Frank Barber, engineer, 40 Jarvis St., Toronto. (Official advertisemen in this issue).

WATER, SEWAGE AND REFUSE

Fort Qu'Appelle, Sask.—Contract for boilers for the Saskatchewan Sanatorium has been awarded by the directors to the Vulcan Iron Works, Ltd., Winnipeg.

Hespeler, Ont.—Tenders addressed to M. E. Jardine, town clerk, will be received by the Hespeler water commission up to 5 p.m., August 30th, 1919, for laying approximately 5,448 lineal feet of water mains. Plans and specifications may be seen at the office of the town clerk. Herbert Johnston, consulting engineer, 130 Lancaster St. E., Kitchener, Ont.

Mimico, Ont.—The town council passed a resolution instructing the town engineer to proceed immediately to lay down sewers and water pipes on all streets included in the estimates of council.

Moose Jaw, Sask.—Tenders will be received until 10 a.m., August 30th, by the city council, for laying of approximately 4,600 lin. ft. of 8-in. and 12-in. sewers, and 4,600 lin. ft. of 6-in. and 8-in. water mains. Laying about 650 lin. ft. wood flume, and 1,600 lin. ft. 8-in. cast-iron pipe, and other works. G. D. Mackie, city commissioner. (Official advertisement in this issue).

Peterborough, Ont.—The water commissioners have decided to construct the new filtration plant on the site of the old Carnegie property, Peterborough county. Estimated cost, $200,000.

Pictou, N.S.—Tenders will be received by A. MacDougall, secretary of building commission, Pictou, N.S., until 9 o'clock a.m., Thursday, August 28th, 1919, for excavating, furnishing materials and completing a sewer from the new county asylum to a point on the East river below the Stellarton pumping station. Plans and specifications may be obtained upon application to Geo. A. McHattie, engineer, Acadia Coal Co. office, Stellarton, N.S.

Sandwich, Ont.—The town council intends to construct 4-in. cast-iron water main on parts of Indian Rd., Peter St. and London St. Estimated cost, $7,708.53. E. R. North, clerk.

St. John, N.B.—The common council has decided to extend the water and sewer mains to Alexander Heights.

Stratford, Ont.—City council intends to construct a 9-inch storm sewer on Chestnut St. and a 9-inch sanitary sewer on Railway Ave. R. R. Lang, city clerk.

York Township, Ont.—Surveys are being made for a proposed system of drainage for Todmorden and the eastern end of the township, discharging into the Don River. Reeve Miller.

York Tp., Ont.—Township council decided to construct 6-inch water mains on Morningside, Kingsway and Garboyd Sts., Riverside Drive and Mossom Rd., 5,883 feet in all. Six of these pipes will also be laid between Vaughan Rd. and Hillbrow on Pinewood Ave. and on Atlas Ave., from Hastings Ave. to Vaughan Rd. Other proposals referred to the engineer were a main on Corbett Ave., from Jane St. to the east end, and on Belvidere Ave., from Oakwood Ave. to Alameda Ave., distances of 1,650 feet and 798 feet, respectively.

LIGHT, HEAT AND POWER

St. Thomas, Ont.—The erection of a large concrete dam above the present storage reservoir was discussed by the water commissioners at a special meeting, and immediate action was decided on.

RAILWAYS

Brockville, Ont.—The local board of trade contemplate requesting the board of railway commissioners to have the local Westport-Brockville subdivision of the C.N. Ry. converted into an electric radial. W. A. Lewis, mayor.

St. Thomas, Ont.—The ratepayers of Port Dover, Port Stanley and intervening territory, will request the Hydro-Electric Power Commission to construct a hydro radial through their district.

FACTORIES AND LARGE BUILDINGS

Alberni, B.C.—Tenders addressed to Duncan C. Scott, deputy superintendent general of Indian affairs, department of Indian affairs, Ottawa, will be received up to noon, September 8th, for the construction of an Indian boarding school. Plans and specifications may be seen at the offices of Inspector Cairns, post office building, Vancouver; Chief Inspector Ditchburn, Victoria; Chas. A. Cox, Alberni; W. R. Robertson, Indian agent, Duncan Station, and with the department at Ottawa.

Arnprior, Ont.—Contract let to Sullivan and Lynn, Arnprior, for the erection of a theatre.

Bedford, Que.—Contract has been awarded by the Missisquoi county council, for repairs to county building to J. Morin, Bedford. Contract, cost plus 15%. E. M. J. Lamoureux, secretary-treasurer.

Brockville, Ont.—An agitation is being made for the erection of a modern hotel at Butternut Bay.

Collingwood, Ont.—The Imperial Wire & Nail Co. expect to rebuild their plant which was recently destroyed by fire.

Creston, B.C.—Contract for the erection of a new one-story high school has been awarded to G. Hendrew. Contract price, $1,925.

Creston, B.C.—The directors of the agricultural association have decided to construct a new fair building and skating rink combined. Estimated cost, $1,500.

Brockville, Ont.—The Brockville Paper Manufacturing Co. will erect a 3-story factory on Park St. Estimated cost, approximately $100,000. J. G. Gardner, president of board of trade.

Brantford, Ont.—Contract has been awarded by C. H. Hyman & Co., London, for construction of a four-story reinforced concrete canning factory to P. H. Secord & Sons' Construction Co., Ltd. Contract price, $125,000.

Carbonear, Nfld.—The Bank of Nova Scotia contemplate construction of a new bank building. Estimated cost, $25,000. C. H. Stewart, Toronto, architect.

Chapleau, Ont.—Tenders will be received until September 15th, by the department of Indian Affairs, Ottawa, for construction of an Indian boarding school. Plans, etc., at offices of A. D. McNabb, Indian agent, Sault Ste. Marie; J. T. Godfrey, Indian agent, Chapleau; post offices, Sudbury and North Bay. Duncan C. Scott, deputy superintendent general.

Ford City, Ont.—Contract has been awarded by the Imperial Oil, Ltd., for construction of a storage building, to R. Wescott, Ltd., Windsor. Estimated cost, $25,000.

Galt, Ont.—No contracts have been awarded, as yet, by the housing commission. Tenders recently received were considered too high and were in excess of the limit set by the government.

Guelph, Ont.—The Fried Grills Hat Co. will erect a large addition to their present building, Suffolk St., to be completed by early spring.

Kitchener, Ont.—The Komavar Chemical Co., Cleveland, Ohio, contemplate establishing a Canadian factory. It is stated that a site may be chosen in Kitchener or in London.

Kitchener, Ont.—The Dominion Rubber System has requested the city council to build 200 new houses under the

Burlington Steel Co., Ltd.
Hamilton, Canada

STEEL BARS
For
Concrete Reinforcing

THE MOST IMPORTANT FACTOR IN CONCRETE REINFORCEMENT IS THE TENSILE STRENGTH AND ELASTIC LIMIT OF THE REINFORCING BAR.

OTHER THINGS BEING EQUAL, STEEL HAVING THE HIGHEST ELASTIC LIMIT, OR YIELD POINT, WILL BE THE MOST SATISFACTORY FOR REINFORCEMENT. WHEN UNDER STRAIN, AS SOON AS THE ELASTIC LIMIT OF ANY REINFORCING BAR IS REACHED, THE METAL STRETCHES RAPIDLY DECREASING IN SECTION, DRAWING LOOSE FROM THE CONCRETE AND DESTROYING THE MONOLITHIC BOND EXISTING BEFORE THIS POINT IS REACHED THEREFORE, THE SAFETY OF THE ENTIRE CONSTRUCTION IS IN DIRECT PROPORTION TO THE ELASTIC LIMIT OF THE STEEL USED.

THE ELASTIC LIMIT OF RAIL CARBON STEEL IS 50,000 TO 60,000 POUNDS PER SQUARE INCH, EITHER TWISTED OR PLAIN, AS COMPARED WITH AN ELASTIC LIMIT OF 25,000 TO 30,000 POUNDS IN SOFT STEEL.

THAT'S WHY RAIL CARBON STEEL, WITH ITS 80,000 POUNDS MINIMUM TENSILE STRENGTH, IS RECOMMENDED AS BEING FAR SUPERIOR FOR ALL KINDS OF REINFORCED CONCRETE WORK.

AT OUR HAMILTON, ONT., WORKS WE BUY SELECT RAILS, AND ROLL THEM INTO RAIL CARBON STEEL REINFORCING BARS IN A PLANT WHICH IS THE EMBODIMENT OF THE LATEST THOUGHT AND PRACTICE.

THESE BARS CAN BE SUPPLIED FROM STOCK IN VARIOUS SIZES, LENGTHS AND SHAPES. WE CAN ALSO ROLL SPECIAL SHAPES AND SIZES TO FIT YOUR PARTICULAR REQUIREMENTS.

Bars bent to shape for Beams, Stirrups, Etc.

PROMPT SHIPMENT

Housing Act. The company, it is understood, would be willing to give a guarantee by which the city might ask for repayment of loan.

Kitsilano, B.C.—Contract has been awarded by the school board for construction of a new high school to E. Crystal & Co. Contract price, $15,483.

Listowel, Ont.—The construction of a $10,000 rink is under consideration. Clerk, Wm. Bright.

London, Ont.—A proposed memorial hall for London, Ont., will be voted upon by the ratepayers next January. Mayor Somerville.

Loretteville, Que.—Tenders will be received until noon, August 23rd, for construction of an Anglican church. Staveley & Staveley, architects, 92 St. Peter St., Quebec, Que.

Moncton, N.B.—Tenders addressed to C. R. Brown, chief engineer, C.N.R., Moncton, N.B., will be received up to 12 o'clock noon, Monday, August 25th, 1919, for the construction of a frame express building, 110 ft. long. Plans and specifications may be seen at the following offices: Chief engineer, Moncton, N.B., terminal agent, C.N.R., St. John, N.B.

Montreal, Que.—La Presse Publishing Co., Ltd., contemplate construction of a new building at the corner of Craig St. and St. Lawrence Blvd.

Montreal, Que.—Plans are being prepared for construction of a nurses' home at the Western Hospital. R. G. Rea, 285 Beaver Hall Hill, architect.

Moose Jaw, Sask.—City council decided to erect an aerodrome in Lynbrook Heights at a cost of $1,750.

Outremont, Que.—The council has awarded contracts for construction of 12 houses to be build on Peronne Ave., on city property. Contract price, $119,400.

Perdue, Sask.—Contract has been awarded by the school board for construction of a new brick school to F. C. Taylor. Contract price, $20,000. J. M. Morrison, architect, Saskatoon.

Port Colborne, Ont.—It is expected that work will commence on reconstruction of part of the government elevator recently partially destroyed by explosion.

Port Hope, Ont.—Tenders will be received by Ellis & Ellis, architects, Manning Chambers, Toronto, up to and including August 30th for proposed extensions and new buildings at the Port Hope Hospital. Plans and specifications may be seen at the office of the town clerk, Port Hope, Ont., and at the office of the architects.

Prince Albert, Sask.—The directors of the Fair Board contemplate the construction of a new grand stand and improvements to the stables. W. O. McDougall, manager.

Quebec, Que.—It is understood that plans are being prepared for a new wing to the parliament buildings, to be built on St. Julia St.

Quebec, P.Q.—It is reported that an option has been taken upon property situated around Sillery Cove for its eventual purchase for the erection of a nine million dollar pulp mill. The promoters are well-known American financiers and practical pulp mill men.

Redcliff, Alta.—Plans are completed for the erection of two large additions to the Dominion Glass Co.'s plant here.

Regina, Sask.—The board of directors of the Regina exhibition will construct an additional 90 ft. to the grandstand. Estimated cost, $25,000. The present bleachers will also be reconstructed.

Regina, Sask.—The city commissioners have decided to forward claim to the receiver of the G.T.P. Ry., asking that company to fulfill its agreement with the city, to erect a million-dollar hotel and a quarter-million-dollar station, for which valuable concessions were granted the railway company in 1911 and 1912.

Regina, Sask.—Contract has been awarded by the commissioners of the R.N.W.M.P. for construction of a new barracks on the southwest corner of the barracks square to the Poole Construction Co. Contract price, $72,000.

Sandwich, Ont.—A Detroit company manufacturing clutches for automobiles, trucks and tractors has secured a site here and proposes to erect a branch plant. Building operations will not be commenced until next year.

Sarnia, Ont.—Herbert Weil and W. J. Reid, of Port Huron, Mich., are planning the erection of a large theatre here.

Saskatoon, Sask.—Tenders will be received until noon, August 25th, for construction of a freight office and extension to freight shed. Plans, etc., at offices of district engineers at Saskatoon and Edmonton. J. Schofield, architect for the C.N. Ry., room 459, Union Station, Winnipeg, Man.

St. Catharines, Ont.—Tenders will be received until 5 p.m., August 22nd, by the suburban road commission for construction of approximately one and seven-tenths mls. of pavement, 18 ft wide, on Ontario St., from St. Catharines to Port Dalhousie. Tenders will be considered for any standard pavement, such as cement concrete, tar macadam or any bituminous surface. W. B. Burgoyne, chairman.

Sydney, N.S.—The Rhodes Curry Co., have been awarded the contract for the construction of the new Holy Redeemer church at Whitney Pier. Architects, Chappell and Hunter, of Charlottetown, P.E.I. Estimated cost, $160,000.

Toronto, Ont.—City Architect Pearse has issued a permit to R. Thornton for an addition and alteration to motion picture theatre on Mavety St., at a cost of $21,000.

Toronto, Ont.—The York Township Housing Commission will receive tenders until August 20th, for construction of seven houses. J. A. Martin, secretary, 40 Jarvis St.

Toronto, Ont.—The King Suspender Co. have purchased site at 129 to 139 Spadina Ave., and will erect a new factory building. Estimated cost, $135,000. H. Greisman, president.

Trenton, Ont.—Tenders will be received until 6 p.m., September 1st, by the Trenton housing commission, for construction of 27 houses. Wm. Lyon Somerville, architect, Imperial Bank Building, Yonge and Bloor Sts., Toronto.

Vancouver, B.C.—The school board will shortly submit a by-law to the ratepayers for $465,000. Included in this amount, Dawson school completion, $72,000; Kitsilano high school, $30,000; temporary additions to schools, $78,000, and proposed technical school, $200,000.

Windsor, Ont.—The ratepayers have voted against the proposed by-law granting certain concessions to the Lamb Railway Service Co., including two-thirds of an acre in the factory district, in return for construction of a $10,000 factory.

Windsor, Ont.—The chamber of commerce has announced the decision of the Fisher Body Co., of Detroit and Walkerville, to establish a branch plant in Canada for the manufacture of closed automobile bodies. A five-story building will be erected in the near future here.

Winnipeg, Man.—Winnipeg's $1,000,000 housing scheme will be proceeded with immediately.

York Township, Ont.—Township Council has been asked to provide for a $60,000 addition to the school in S.S. 26 at the corner of Barrington and Secord Avenues. Clerk W. A. Clarke.

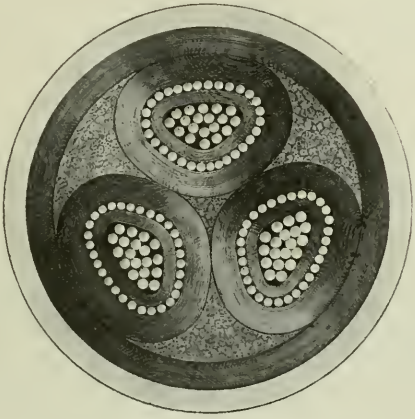
York Township, Ont.—Tenders will be received until 12 o'clock noon, August 25th, by the township council for construction of a reinforced concrete bridge, 18-ft. span, on the 3rd concession east of Yonge St, near Duncan Station; two reinforced concrete culverts on Horseham and Hounslow Ave.; concrete truss bridge on Buson Rd. Frank Barber, engineer, 40 Jarvis St.

MISCELLANEOUS

Boisdale, N.S.—Tenders will be received until 12 o'clock noon, September 3rd, by the Department of Public Works, Ottawa, for construction of a wharf at Boisdale, N.S. Plans, etc., at offices of district engineer, North Sydney, N.S., and at post office, Boisdale, N.S. R. C. Desrochers, secretary.

Connaught Station, Ont.—The timber pilework wharf, for which tenders were called for noon, July 15th, by the

SPLIT-CONDUCTOR CABLES



250,000 C.M. 3-CONDUCTOR 13,200 VOLT
PAPER-INSULATED, LEAD COVERED CABLE

Eugene F. Phillips Electrical Works, Ltd.

MONTREAL

Branches: Toronto, Winnipeg, Regina, Calgary, Vancouver

Department of Public Works, Ottawa, will be constructed by day labor. R. C. Desrochers, secretary.

Cornwall, Ont.—Tenders will be received until 12 o'clock noon, August 26th, by the Department of Railways and Canals, Ottawa, for improving upper entrance to lock 18. Plans, etc., at offices of chief engineer, Ottawa, and superintending engineer, Cornwall, Ont. J. W. Pugsley, secretary.

Ingersoll, Ont.—The park committee have decided to construct a reinforced concrete retaining wall along the north end of the new park.

Laprairie, Que.—Tenders will be received by the department of public works until 12 o'clock noon, August 28th, for protection works at Laprairie, county of Laprairie, Que. Plans, etc., at offices of district engineers, Shaughnessy Building, Montreal, and post office, Quebec, and at the post office, Laprairie, Que. R. C. Desrochers, secretary.

Morden, Man.—Tenders will be received until August 23rd, by Stanley municipal council, for construction of reinforced concrete culvert, north of section 1-1-6 W. C. McCorquodale, secretary-treasurer.

New Glasgow, N.S.—Tenders for plumbing for the nurses' home in connection with the Aberdeen Hospital, will be received by J. C. McGregor, up to Tuesday, August 26th. Plans and specifications may be seen at the office of J. W. Carmichael and Co., New Glasgow.

Peterborough, Ont.—City council contemplates purchase of one or two power street flushers. City engineer, R. H. Parsons.

Pincher Creek, Alta.—At a joint meeting of the United Farmers' Association, and the ratepayers, the following resolution was adopted: That the Dominion government be requested to make this summer, a survey to determine the feasibility of constructing irrigation works to irrigate the Summerview district, the Cowley district, the Pincher Creek flats and the district south of Pincher Creek. H. E. Hyde, mayor, Pincher Creek.

Prince Rupert, B.C.—Contract has been awarded by the marine department for construction of a steel and concrete lighthouse on Triple Island to J. H. Hilditch.

Saskatoon, Sask.—Contract has been awarded for installation of one 4,000,000 gallon pump, head 102 ft.: one 1,000,000 gallon and one 4,000,000 gallon pump, head 40 ft., by the city council, to Goldie & McCullough Co. Contract price, $11,176. Rejected tenders, Turbine Equipment Co., $11,010; Canadian Allis-Chalmers, $11,815. G. D. Archibald, engineer.

St. Jean d'Orleans, P.Q.—Tenders addressed to R. C. Desrochers, secretary, department of public works, Ottawa, will be received until 12 o'clock noon, Wednesday, September 3, 1919, for the construction of repairs to wharf at St. Jean d'Orleans, county of Montmorency, Que. Plans and forms of contract can be seen and specification and form of tender obtained at the department of public works, Ottawa, and at the offices of the district engineers, Post Office Building, Quebec, Que., Shaughnessy Building, Montreal, Que., and at the post office, St. Jean d'Orleans, Que.

St. John, N.B.—Contract has been awarded by the common council for terra cotta pipe as follows: 800 ft., 12 in., $52.10 per 100 ft., to Jas. Robertson Co., Ltd.; 1,200 ft., 9 in., to T. McAvity and Sons, Ltd.

Sydney, N.S.—The Sydney Foundry and Machine Co. is applying for a site on which to construct a drydock for this port.

Toronto, Ont.—Local improvement by-laws will be considered at a special meeting of the city council to-night for work amounting to over $700,000. According to Assistant City Engineer Powell, in the event of all the by-laws being passed by council, a great amount of the work will be started immediately, and will be completed this year.

Toronto, Ont.—Tenders addressed to T. L. Church, mayor, chairman, board of control, City Hall, Toronto, will be received up to noon on Tuesday, August 26th, 1919, for the complete supply and erection of metal fire escapes on the Isolation Hospital Buildings. Specifications, etc., may be seen at the office of the property department, City Hall.

Toronto, Ont.—Tenders will be received until 12 o'clock noon, September 5th, by the Department of Public Works, Ottawa, for provision and installation of interior fittings in terminal postal station "A," Toronto. Plans, etc., at offices of chief architect, Ottawa; resident architect, 61 Front St. West; superintendent of Dominion public buildings, postal station "F," Toronto, and overseer Dominion buildings, central post office, Montreal, Que. R. C. Desrochers, secretary.

Trail, B.C.—The city council has awarded contract for 1,500 lin. ft. of four-inch steel water pipe and six four-inch gate valves, to Gordon & Belyea, Vancouver, B.C.

Vancouver, B.C.—The board of works contemplate construction of a pivot pier and protection fenders for the Granville St. bridge. City Engineer Fellowes.

Vancouver, B.C.—The city council has authorized the purchase of an American La France gasoline pumping engine for the fire department at a cost of $15,650.

Wallaceburg, Ont.—It is understood that the Great Lakes Refining Co., Wallaceburg, have purchased a property and will erect a number of storage tanks.

Weston, Ont.—The Weston council has decided to call for tenders for a fully equipped motor truck, with chemical appliances, for the fire department. Fire Chief Pollard.

Windsor, Ont.—The ratepayers have voted against the proposed by-law to provide $15,000 for a fire engine and $20,000 for two motor flushers.

Winnipeg, Man.—Tenders will be received by the C.N. Ry. until August 25th, for construction of turntable foundations at Kamsack, Sask., and Dauphin, Man., for track-scale foundations at North Battleford, Sask., Big Valley, Sask., and Swan River, Man. Plans, etc., at offices of the district engineers at Saskatoon and Edmonton. J. Schofield, architect, room 459, Union Station, Winnipeg.

Tenders Called For

TOWN OF HESPELER

WATERWORKS EXTENSION

Sealed tenders addressed to M. E. Jardine, Town Clerk, Hespeler, will be received by the Hespeler Water Commission up to 5 p.m., August 30, 1919, for laying approximately 5,448 lineal feet of water mains.

Plans and specifications may be seen at the Office of the Town Clerk, Hespeler, Ontario.

The lowest or any tender will not necessarily be accepted.

HERBERT JOHNSTON,
Consulting Engineer.
130 Lancaster St. E., Kitchener, Ontario. 328

TENDERS FOR PAVEMENT

Sealed tenders, marked "Tenders for Pavement," will be received by the undersigned up till 12 o'clock noon, Friday, August 29th, for the construction of approximately 1,550 lineal feet of curb and gutter; 4,300 square yards of Asphalt, Asphaltic Concrete or Bitulithic pavement on 6-in. Concrete Base.

Tenderer to submit prices for standard Asphalt, Asphaltic Concrete or Bitulithic pavements.

Plans and all necessary information may be obtained at the office of the City Engineer, City Hall.

A marked cheque made payable to the City Treasurer of five per cent. (5%) must accompany each tender.

The lowest or any tender not necessarily accepted.

C. B. SYMES,
City Engineer. 325

Fort William, August 14th, 1919.

The Canadian Engineer

A Weekly Paper for Civil Engineers and Contractors

Progress of Queenston-Chippawa Power Canal

Nearly Five Million Cubic Yards of Earth and Rock Removed—Huge Shovel Establishes Record in Loading 8,500 Cubic Yards on Cars in 20 Hours—Extensive Construction Railway Handling 200 Trains Daily—Payroll Only 1,000 Men Per Shift—Construction Equipment Worth Several Million Dollars

WITH several million dollars' worth of equipment on the job, and a pay roll of 2,000 men, the Hydro-Electric Power Commission of Ontario is making rapid progress on the Queenston-Chippawa power development. The construction organization has been perfected, any probable difficulties in excavation have been adequately met, the overburden has been stripped from nearly half the length of the canal, considerable rock has been taken out, the forebay is nearing completion, the power house site has been cleared, the construction railway into the power house site is being graded, the hydraulic turbines and the generators are under construction; in brief, it is now almost solely a matter of digging, channeling, drilling and blasting to complete what will probably be the largest and one of the most efficient hydro-electric plants in the world, developing at least 300,000 h.p. under 305 ft. average net head.

In the June 20th, 1918, issue of *The Canadian Engineer*, pages 545 to 550 inclusive, appeared an article which dealt with the economics and design of this development. In the September 26th and November 21st, 1918, issues respectively appeared brief descriptions of the proposed turbines and generators. The present article is intended primarily to deal with the methods of construction and the progress that has been made to date.

POWER-HOUSE SITE CLEARED—VIEW FROM THE UNITED STATES BANK OF THE NIAGARA RIVER—LEWISTON BRIDGE, ABOUT A MILE DOWNSTREAM, CAN BE SEEN AT EXTREME RIGHT OF PHOTO

Referring to the accompanying profile, it will be noted that the canal is entirely in rock excepting from about Sta. 335 to Sta. 350, near the Whirlpool, and from Sta. 0 to Sta. 40, adjacent to the Welland river.

From Sta. 273 (Niagara, St. Catharines & Thorold Railway) to Sta. 460 (the forebay) the canal section has been entirely stripped to rock with the exception of a small amount of work remaining to be done near the Whirlpool gully. Three electrically-driven shovels are at work removing the overburden between Sta. 100 and Sta. 273. With the exception of pilot cuts, practically no earth has been moved between the Welland river and Sta. 200. Rapid progress is being made with the Welland river section of the work, which is being handled by a dredge and a cableway excavator.

A large quantity of rock has been removed at the forebay and between the forebay and Sta. 273.

There are ten power shovels at work on the canal, all manufactured by the Bucyrus Co. The three largest are electrically-driven, each being equipped with an 8 cu. yd. bucket for excavation in earth, and each weighing 400 tons. There are also three electrically-driven shovels each equipped with buckets of 4½ cu. yds. capacity, and one electrically-driven shovel (with caterpillar traction) equipped with a ⅞-yd. bucket. There are three steam shovels, one having a bucket of 2 yds. capacity, one 1-yd. and one ⅞-yd., the latter two having caterpillar traction.

An 8-yd. shovel is at work at the forebay removing the rock to a depth of about 45 ft. The first lift of rock has been entirely removed to a width of 300 ft. at the gate house and the remainder of the rock to the necessary depth has been drilled and blasted to a total width of 500 ft. at the gate-house and is now being loaded by the shovel. Tracks have been laid on top of the blasted rock, at an elevation about 30 ft. above the shovel's tracks, and the electrically-hauled trains of dump cars are run over the rock directly to the shovel.

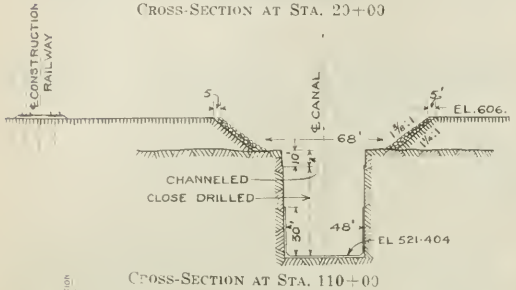
Between the forebay and Sta. 273, two other shovels are working in rock, one 8-yd. and one 4½-yd. capacity. It should be stated that these capacities, as well as those mentioned above, are the capacities of these shovels in earth. The capacities in rock are, of course, proportionately smaller. For example, each 8-yd. shovel has a capacity of 5½ cu. yds. in rock.

The two shovels that are working in rock between the forebay and Sta. 273, started at Station 295 and are going in opposite directions, the big one working toward the Welland river and the 4½-yd. shovel going toward the forebay, both working on the first lift of rock.

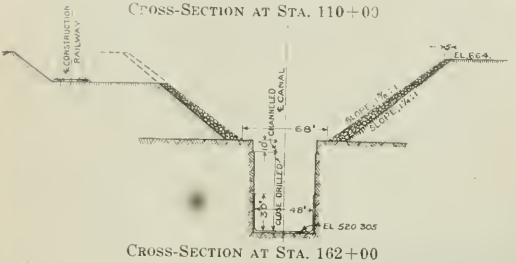
Channeling, drilling and blasting proceeds almost incessantly, day and night, ahead of the shovels. The shovels are being operated by two shifts of ten hours each, an adequate equipment of flood lamps providing plenty of illumination for carrying on the work at night.

A 4½-yd. shovel is at work at the Whirlpool cleaning up the bottom preparatory to the riprap construction.

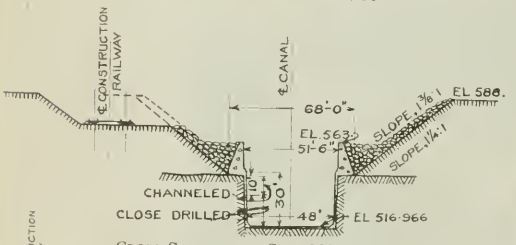
Cross-Section at Sta. 20+00



Cross-Section at Sta. 110+00

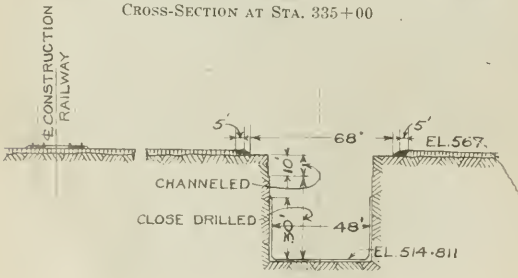


Cross-Section at Sta. 162+00



Cross-Section at Sta. 320+00

Cross-Section at Sta. 335+00



Cross-Section at Sta. 422+00

The 1-yd. shovel is working toward the Welland river, south of Sta. 323 (the Grand Trunk bridge), cleaning the rock preparatory to channeling.

Between the Niagara, St. Catharines & Thorold Railway (Sta. 273) and Muddy Run creek (Sta. 200), there are

Battery of Rand and Sullivan Rock Drills at the Forebay

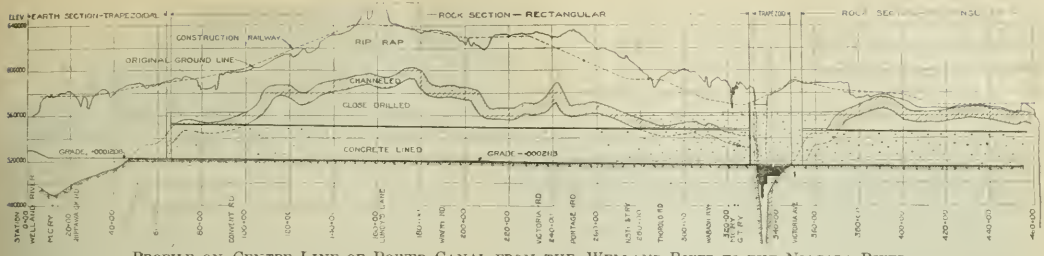
three shovels working in earth: One 8-yd. shovel, one 4½-yd. and one 2-yd.

The steam-driven ⅞-yd. shovel is working south of Muddy Run, digging pilot cuts, ditching, loading, ballasting and doing other miscellaneous preparatory work. The electrically-driven ⅞-yd. shovel is grading the construction railway from Queenston to the power-house site.

Among the other plant on the job are 21 electric locomotives, 7 steam locomotives, 150 twenty-yard Western steel dump cars, 50 sixteen-yard Western wooden dump cars, 12 box and flat cars, one 5-yd. dredge, one Ligerwood cableway excavator (800-ft. span), 2 draglines each equipped with a

Crane Moving Rock in Skips from Canal Section at Entrance to Forebay

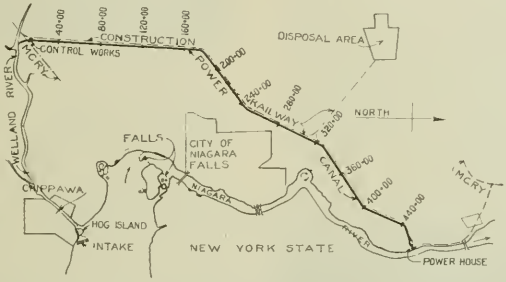
one-yd. bucket, 2 White motor dump trucks, 1 Sawyer-Massey traction engine, 10 Troy 3-yd. dump wagons, 1 Sawyer-Massey road scraper, 3 Bay City cranes of 40-tons capacity at 16½ ft. radius, 2 Bay City cranes of 15 tons capacity at 16½ ft. radius, 2 London concrete mixers, 4 Ransome concrete mixers, 1 Wettlauffer concrete mixer (each of these 7 mixers having a capacity of approximately 1 cu. yd. of mixed concrete), 2 cement-guns of the N-2 type, 1 Ransome grout mixer, 1 McKenna bar bender, several Sterling concrete carts, 1 Stephens-Adamson crushed stone conveyer, 75 Sullivan rock drills, 8 Ingersoll-Rand rock drills, 2 Leyner oil furnaces, 3 Sullivan drill sharpeners, 1 McKiernan-Terry pile hammer, 1 Vulcan pile hammer, 1 Beatty clam-shell bucket, 1 Hayward orange-peel bucket, 1 Orton & Steinbrenner ¾-yd.



PROFILE ON CENTRE LINE OF POWER CANAL FROM THE WELLAND RIVER TO THE NIAGARA RIVER

bucket, 1 Hayward 1½-yd. clam-shell bucket (motor driven), 1 Andresen-Evans 3-yd. bucket (on cableway excavator), 12 Sullivan channellers, 1 McCully No. 5 gyratory crusher, 2 McCully No. 6 gyratory crushers, 1 McCully No. 7½ gyratory crusher, 2 Barber-Green 60-ft. portable conveyors, 1 Traylor 60-in. by 84-in. steel jaw crusher, 36 thousand-watt Davis flood lamps, 13 four-hundred-watt Lyman flood lamps, 2 Napance hoists, 1 Ligerwood hoist, 1 Beatty hoist, 2 Jordan spreaders, 2 Imperial tie tampers, 1 double-track snow plow built by Canadian Steel Foundries, numerous Herbert Morris hoists, 2 Lincoln track bonders, numerous Norton Jacks and a large quantity of valves, hydrants, pipe, tanks, standpipes, searchlights, transformers, motors, etc. There are about 36 pumps of various types and capacities, a few of which are operated continuously, the others being held for emergencies and intermittent use.

The job is equipped with its own telephone system, which also is connected by private wire direct to the head office of the Hydro-Electric Power Commission in Toronto, and with its own water distribution system and electric light system.



PLAN OF QUEENSTON-CHIPPAWA POWER CANAL

Fifty-five miles of construction railway have been built, including yards, sidings, etc. The 2½ miles of railway from the canal to the disposal area is one of the busiest double track lines in America, carrying from 180 to 200 trains (of ten cars each) daily during the 20 working hours. A despatching system, controlled by telephone, has been found necessary, especially at night.

In the Whirlpool yards are located a large machine shop, store houses, cement stores, forges, etc. The list of equipment above mentioned does not include the many machine tools, trip-hammers, wood-working machines, welding outfits, etc., with which these buildings are equipped nor the thousand and one items with which the store-houses are filled to the roofs in orderly bins and racks, including everything that might possibly be needed, from safety pins and iodine to dynamite and structural steel.

The main transformer house is at station 320. Here are installed 12 Sullivan air compressors, each having a capacity of 1,000 cu. ft. per minute against 125 lbs. pressure. The installed transformer capacity at the station is about 7,500 k.v.a., of which 3,000 k.w. is direct current.

Another transformer house is being erected at Sta. 90. A small transformer house was erected near Chippawa at the beginning of the work for the purpose of supplying the Welland river section. All power is obtained from the Ontario Power Co., which is now controlled by the Hydro-Electric Power Commission. The compressed air is used for operating the drills and channellers and for numerous small tools. It is piped in double 8-in. and single 10-in. lines, with valves every 500 ft.

The first shovel on the job was the 2-yd. Atlantic type shovel, which began work in the spring of 1917 at Sta. 324. Since then there has been removed to date a total of a little more than 4,000,000 cu. yds. of earth and 500,000 cu. yds. of rock. The excavating plant has been increased continuously, two of the largest shovels having been received only a few months ago, and the work is now progressing 50% faster than previously. Since January 1st, 1919, approximately 2,200,000 cu. yds. of earth and 350,000 cu. yds. of rock have been removed, partly by the dredge, partly by the cableway excavator and partly by miscellaneous equipment, but mostly by the shovels.

The best day's record for any one shovel was the loading of 420 cars in two 10 hr. shifts, this being equivalent to 8,500 cu. yds. bank measurement.

The total amount of material to be excavated from the canal section is 9,000,000 cu. yds. of earth and 4,000,000 cu.

CHANNELERS AT WORK—AT LEFT, STA. 316+25—AT RIGHT, STA. 419+00, SHOWING TRAVELLING SMITHY MOUNTED ON TRUCKS

Two Views Showing Channel Cut—At Left, Sta. 443+00, Looking West—At Right, Sta. 448+00

yds. of rock; and from the river section, 2,000,000 cu. yds., mostly earth. These figures include the work already done.

The heavy rock fill section across the Whirlpool gully, illustrated on page 250 by the section at Sta. 335+00, is in an advanced stage of construction, approximately 50% of the rock being already in place. Behind the rock fill the whole of the gully is being backfilled with earth to the extent of 1,500,000 cu. yds., 80% of which is now in place. Each rock fill flanking the canal at this point has the following dimensions: Length at top, 650 ft.; length at base, 350 ft.; width at top, 20 ft.; width at base, 160 ft. Between these

Jordan Spreader Pushing Back Dumped Earth at St. David's Disposal Area

rock fills the base of the canal section is backfilled with rock to a depth of 8 ft.

Incidentally it may be mentioned that the filling of the Whirlpool gully and its offshoots will reclaim a considerable tract of land that will ultimately be of great value for factory sites.

The power-house site, which is at the foot of the steep cliff just above the Lewiston bridge, was difficult of access. An electric shovel is now cutting its way from Queenston to the power-house site, along the bank of the river, about 30 ft. above normal water level. Besides cutting its own path, the shovel is doing the necessary grading for the construction railway, which will run right into the power-house site.

As can be seen from the sketch on page 255, this construction railway connects with the Michigan Central, making use of a portion of the International Railway's present tracks and also of the new tracks that will be built by the International Railway. This new route will give the International Railway a better approach, having a much less dangerous grade, to the Queenston dock, and will also permit the use of the large gully south of the dock as a dump for the material excavated from the power-house site.

The construction railway has been completed from the forebay to Sta. 170, and to the disposal area at St. David's. It has also been constructed from the Welland river to Sta. 40, and will soon be connected between Sta. 40 and Sta. 170. Switching arrangements have been completed at the Welland river for interchanging traffic with the Michigan Central's Welland-to-Niagara Falls line.

The channel south of Hog Island, where the intake will be constructed, is being widened and deepened, and this work is practically completed. The dredge is now working in the Welland river digging out the piers of the old highway bridge. The dredged material is floated down the Niagara river on scows and dumped. An "unloader" is moored to a stone-filled crib in the river, and the scows are controlled by the steel wire cable running from the drum of this "unloader," with the result that only two tugs are required to guide each loaded scow and "spot" it over the dumping site; moreover, the chance of a scow breaking loose from the tugs and going over the Falls is largely obviated.

Train Unloading at St. David's Disposal Area—Note Low-Lying Grounds at Left, Providing Dump 200 Acres in Extent

The towers for the cableway, which is being used to a great extent in the widening of the Welland river, run on standard gauge tracks. Each tower has two tracks at 40-ft. centres and hauls itself along by its own motor by means of a line to a deadman. No work has been done as yet on the control works at the junction of the canal with the Welland river, nor in connection with the intake itself.

Prof. R. W. Angus, of the University of Toronto, has been engaged this summer and last summer in experiments with hydraulic similarity models at Dufferin Islands, near the Ontario Power Co.'s intake in the Niagara river; and the Chippawa intake, which will extend into the river from Hog Island, as roughly indicated on the plan on page 251, will be built in accordance with the results of these experiments.

It is likely that this structure will be of concrete, so designed as to be able to take the water from the bottom of the river whenever desirable in order to avoid ice.

The control works near the junction of the canal and the Welland river will consist mainly of Stoney sluices, so arranged that the canal can be unwatered at any time in case of emergency.

Experiments are now being conducted regarding the relative efficiencies of concrete and gunite (the sand-cement

⅞-Yd. Shovel at the G.T.R. and M.C.R. Diversion

product shot by cement-guns) linings for the portions of the canal that are in rock. It has not yet been fully decided by what method, or to what extent, the canal will be lined. Wherever the canal is in rock, however, it will be lined to a height of at least 30 ft. from the bottom, and in the earth sections it will be lined everywhere to El. 563. At the Welland river for example, the bottom of the canal is approximately at El. 523, so the sides there will be lined for a height of 40 ft.

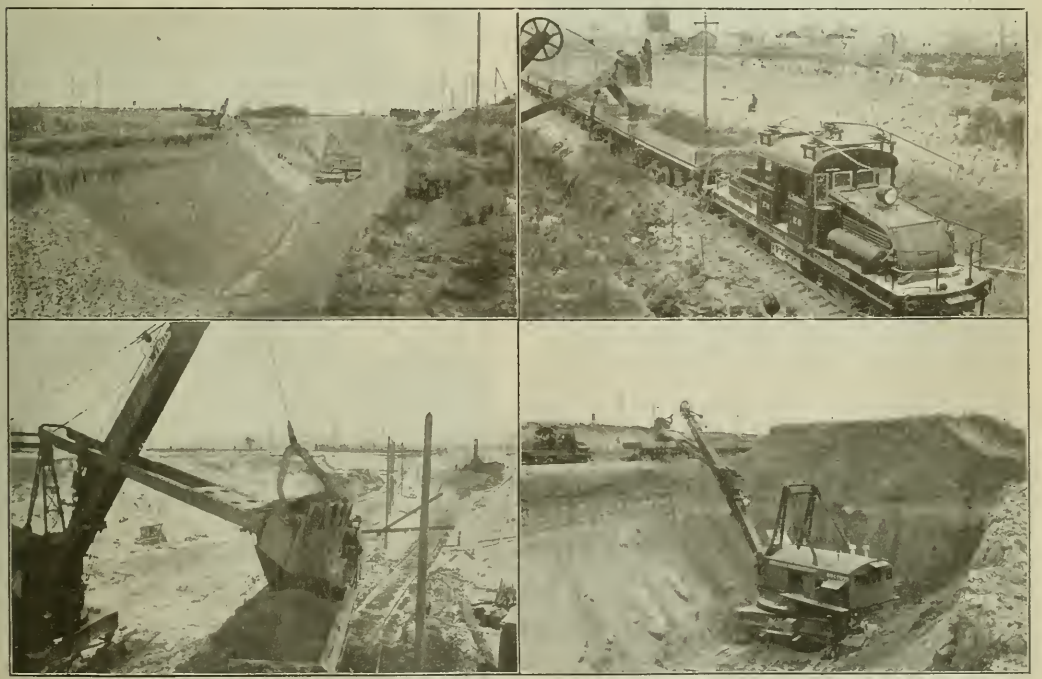
Over 130 buildings have been built, moved or repaired

4½-Yd. Shovel in Rock at the Forebay

during the course of construction to date. Most of the new buildings are of a temporary nature.

Among other work which is being carried out by the commission to remedy the changes in the landscape that are being caused by the power canal, is the construction of several bridges.

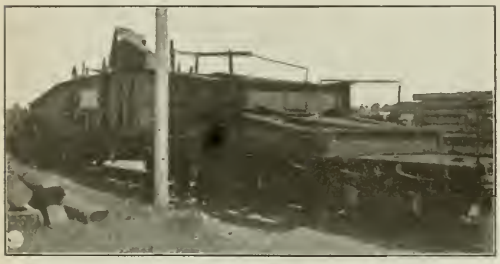
A reinforced concrete arch, 86-ft. span, to carry the Niagara, St. Catharines & Thorold Railway across the canal,



Four Views of One of the 8-Yd. Shovels Working in Earth—Top Left Photo Shows Some Rip Rap in Place—Top Right, Train Being Loaded at Sta. 346+81—Bottom Left, Working South of the Wabash R'y—Bottom Right, Working Against a High Face at Sta. 346+81

Crusher Plant—Primary Traylor Crusher at Left, Gyratories in Centre, Screens About to be Erected at Right—Capacity, 3,500 Cu. Yds. Daily

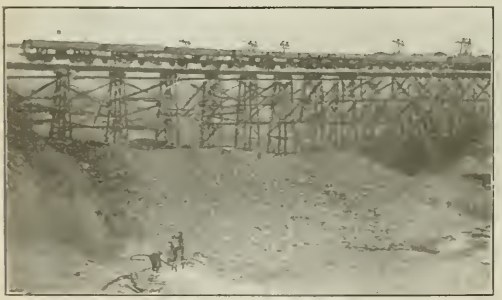
is practically completed. An arch of 100 ft. span has been built to carry the Wabash Railway. Where the Grand Trunk Railway and the Michigan Central Railway cross the line of the canal, the tracks are only about 90 ft. apart; therefore, with a view to future requirements, the skew arches that will carry these railways across the canal will be carried though, making one continuous structure and providing ample room for additional tracks. These two railways have been temporarily diverted during the con-



The Bethlehem Steel Co.'s Special Artillery Truck Was Required to Carry the Massive Parts of the Traylor Jaw Crusher

struction of this bridge, and work has begun on the foundations.

The N. St. C. & T. R'y bridge involved the diversion of the existing single track to one side of the bridge site and the construction of a double track reinforced concrete arch with 86 ft. span, having a rise of 25 ft. This arch was designed for Coopers' E-60 loading, and contains approximately 3,500 cu. yds. of concrete and over 90 tons of steel. The depth from base of rail to foundations is 52 ft. Lackawanna sheet piling was driven around the abutments, cofferdams were unwatered and material excavated to required depth after a great deal of trouble was caused by the satura-



Dumping Rock from Trestle for Fill at the Whirlpool Gully

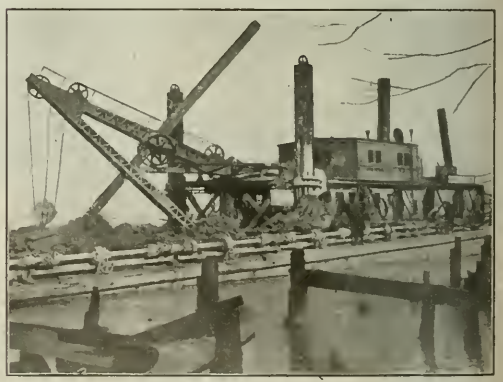
tion of the surrounding subsoil. The arch was completed and traffic restored to the original alignment last December. A temporary timber trestle was designed to carry the N. St. C. & T. R'y line over the construction railway tracks, which are in the canal prism and parallel to the centre line of the canal.

The Wabash line was diverted on a timber trestle over 40 ft. high, extending across the previously excavated canal section. The excavation of the canal prism thus provided natural drainage for the foundations for the 100-ft. reinforced concrete arch. This arch differs in design from the N. St. C. & T. R'y arch, as the Wabash arch has straight wing gravity walls instead of the reinforced cantilever type

Scow-Lowering and Rehauling Outfit at Work on the Niagara River

used in the other arch. There are approximately 3,000 yds. of concrete and 65 tons of reinforcing steel in the construction. The structure provides for two tracks, spaced 13 ft. centres, which will take care of the requirements of that railway for many years. The main line tracks of the Wabash are also carried over the construction railway by means of a temporary trestle.

A 3-track trestle about 400 ft. long has been built for the diversion of the main line of the Grand Trunk and the branch line of the Michigan Central. Upon completion of the



Dredge at Work on the Welland River

outside portions of the new arch, it is intended to re-divert traffic to the present alignment. The new structure will be a reinforced concrete arch, having a span of 72 ft. and rise of 20 ft. and involving the placing of 10,000 cubic yards of concrete and 325 tons of steel. It will provide room for 10 tracks. In the restoration of the G.T.R. and M.C.R. to the original alignment, a temporary timber trestle will carry the tracks over the construction railway. The trestles for diversion and relocation of these railways involve the use of over 300,000 ft. of timber.

View from East End of Lewiston Bridge, Showing Nature of the Cliff Along Which ⅞-Yd. Electric Shovel is Cutting Path for Construction Railway, 30 Ft. Above Water Level

The completion of these three arches will greatly assist the progress of excavation, as the equipment will then be free to move to any point, and the innumerable delays occasioned by the railways will be entirely eliminated, and the output of the excavating equipment will not be hampered in its course to the disposal area.

At Lundy's Lane, the highway is now being diverted to the north to a point where the construction railway is at the same elevation as the original ground line. This is preparatory to making the cut at Lundy's Lane, after which a highway bridge will probably be constructed across the canal at a point most favorable in respect to grades and detours.

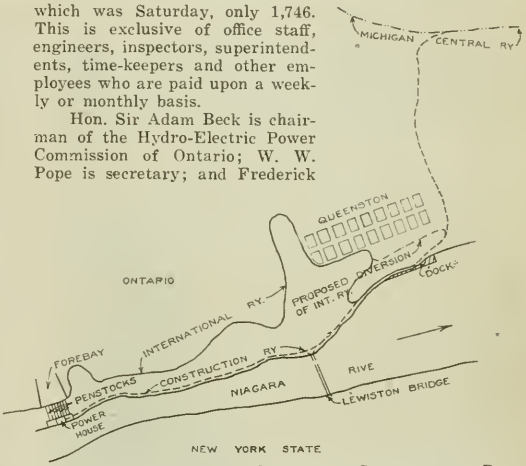
Two new bridges must be built across the Welland river on account of the enlargement of that stream. These bridges will be of steel, and excavation is now in progress for their foundations. The Michigan Central Railway bridge will be a

Looking Across Niagara River from Hog Island—The Intake Will Extend Into the River from this Island

swing span, and the highway bridge will be a bascule, with a 90-ft. leaf.

The number of men on the daily pay-roll varies considerably; for instance, on August 14th, 1919, exactly 1,884 men reported for work; the following day, 1,905; on August 16th, which was Saturday, only 1,746. This is exclusive of office staff, engineers, inspectors, superintendents, time-keepers and other employees who are paid upon a weekly or monthly basis.

Hon. Sir Adam Beck is chairman of the Hydro-Electric Power Commission of Ontario; W. W. Pope is secretary; and Frederick



Plan Showing Route of Queenston Construction Railway now Being Graded, and Proposed Diverson of International Railway's Line to the Dock

A. Gaby is chief engineer. The design and construction of the Queenston-Chippawa project, with the exception of the electrical work, are under the direction of the Commission's hydraulic department, of which Henry G. Acres is the hydraulic engineer; Thos. H. Hogg, assistant hydraulic engineer; and Max V. Sauer, designing engineer.

E. T. Brandon is the electrical engineer of the Commission; and Arthur H. Hull, assistant electrical engineer.

At Niagara Falls there is a large staff under the direction of J. B. Goodwin, works engineer, and of George Angell, general superintendent of construction. A. C. D. Blanchard

Looking Up the Welland River, Hog Island at the Right—Before and After Widening the Intake Channel of the Canalized River Section

DREDGING THE WELLAND RIVER—A BUCKETFUL

is chief field engineer; Francis W. Clark, division engineer in charge of the intake, river section and canal; and Walter Jackson, division engineer in charge of the forebay and power-house. The resident engineers are W. S. Orr, Division No. 1 (river section); C. H. McDougall, Division No. 2 (Welland river to Sta. 235); and George H. Lowry, Division No.

THE CABLEWAY EXCAVATOR HAS AN 800 FT. SPAN

3 (Sta. 235 to Sta. 438). Channel Anderson is superintendent of Division No. 1; F. W. Scriven, of Division No. 3; and W. L. LeRoy, of Division No. 4 (forebay, power-house and Queenston construction railway). Harold L. Bucke is superintendent of railway construction; R. T. Gent, plant engineer; P. Reid, mechanical superintendent; and F. F. Cooper, chief clerk.

Arrangements have now been practically completed whereby the American Water Works Manufacturers' Association will assume responsibility for the exhibit features as well as the entertainment program of the New England and also the Southwestern Water Works Association conventions, along the same lines as are now prevailing at the American Water Works Association conventions. In order to accomplish this and to meet the conditions prevailing in these two associations (namely, that they have associate members who are distinctly local in their character and not interested in the activities of any other association such as the American Water Works), the executive committee of the Manufacturers' Association have unanimously approved amendments to the constitution establishing a sectional membership, the purpose being to limit the activities of the sectional members to the one organization with which they are associated.

ALBERTA INDUSTRIAL CONGRESS

(Staff Correspondence)

THE opening session of the Alberta Industrial Congress, the first meeting of its kind in western Canada, was held August 13th, in Calgary. On the two preceding days the delegates had visited Medicine Hat and Lethbridge with a view to seeing the southern portion of the province. After spending two days in Calgary for the business meetings, they went to Edmonton on the 15th. The general impression gained by the delegates was that this is the beginning of a movement which will develop from year to year and awaken the people of Canada to the wonderful possibilities of the west, not only as regards agriculture, which is already recognized, but for industrial purposes. M. A. Brown, mayor of Medicine Hat, acted as chairman of the Congress.

The congress received several addresses of outstanding interest. Dr. A. B. Macallum, chairman of the Council for Scientific and Industrial Research, said that Alberta's coal supply would last only five thousand years with the present population or two thousand years with a population of twenty millions. Canada needed an organized institution that would direct the development of her natural resources. Eugene Coste said Alberta had the biggest oil fields in the world, 1,600 miles by 300 miles wide. A defense of government ownership of railways in its practical working was made by E. A. Warren, general manager of the Canadian National Railways.

Development of the West

A remarkable story of the industrial development of the west in general, and Alberta in particular, was told by J. E. Walsh, general manager of the Canadian Manufacturers' Association.

"Some idea of the development of manufacturing in western Canada," said Mr. Walsh, "is given in the table which has been compiled on this subject. This table goes as far as 1917, and does not show the increases of the last two years, which have been considerable. The figures for the three prairie provinces—Manitoba Saskatchewan and Alberta, are:—

Year.	No. of Establishments.	Capital.
1900	429	$ 9,229,561
1905	554	37,036,193
1910	902	84,479,837
1915	1,881	154,874,530
1917	4,082	197,475,107

"These figures show what a remarkable increase took place in the last two years accounted for. For the period between 1900 and 1917, the figures for the whole of Canada are: In 1900, number of establishments, 14,650, and capital $446,916,437. In 1917 there were, established 34,380 and capital $2,772,517,680."

"The Coal Areas in Alberta" was the subject of an address by D. B. Dowling. He traced the geological formation of the Alberta coal fields and mentioned the surface seam of anthracite in the Crow's Nest district, which is 135 feet thick. Because of its vast resources of soft coal Alberta is, he said, similar to Wales.

Alberta's Power Resources

James White, assistant to the chairman of the Commission of Conservation, dealt with "Power of Alberta—Water, Coal and Natural Gas." Referring to the development of power throughout the world, he stated that 75,000,000 horsepower had been developed, of which 29,000,000 is used in the United States, 13,000,000 in the United Kingdom and 6,000,000 in the British Dominion and dependencies. So far as water power is concerned, Calgary is more valuably situated than any other city in Alberta, the six powers on the Bow River having an aggregate minimum of 60,000 horse-power with regulated river and less than one-half of that amount with unregulated river. The Rocky Rapid power on the Northern Saskatchewan, which is sixty miles from Edmonton, would require the erection of a dam 85,000 feet

(Concluded on page 266)

NATIONAL INDUSTRIAL CONGRESS

FOLLOWING the meeting recently held in Ottawa by the labor sub-committee of the Reconstruction and Development Committee of the Cabinet, the Dominion government has announced that a national industrial conference will be held in Ottawa, beginning September 11th. Following is the agenda:—

(1) Consideration of the question of the desirability of unifying and co-ordinating the existing labor laws of the Dominion parliament and of the provincial legislatures, and the consideration of any new labor laws which are deemed necessary.

(2) Consideration of: (a) Employees' right to organize; (b) recognition of labor unions; (c) the right of employees to collective bargaining.

(3) Consideration of: (a) The recommendations of the Royal Commission on Industrial Relations in favor of the establishment of a bureau to promote the establishment and development of Joint Industrial Councils; (b) the further recommendations of the Royal Commission on Industrial Relations regarding the establishment of joint plant and industrial councils.

(4) Consideration of the recommendation of the Royal Commission on Industrial Relations respecting hours of labor.

(5) Consideration of minimum wage laws.

(6) Consideration of the recommendation of the Royal Commission on Industrial Relations that the findings of the commission be put into effect in all work controlled by the government where the principles of democratic management can be applied.

(7) Consideration of resolutions relating to any other features of the Royal Commission report.

(8) Consideration of the labor features of the Treaty of Peace.

(9) Consideration of any other proposals which may be introduced bearing on the relations of employers and employees.

In connection with the present industrial situation, Sir Robert Borden has issued the following statement:—

"As announced in the Governor-General's speech at prorogation, it is the intention of the government to summon, within a few weeks, a representative conference for the purpose of an intimate and friendly discussion of relations between employers and employed, and for consideration of the report of the industrial relations commission. The provincial governments will be invited to attend, and the various organizations of employers and employed will be requested to appoint representatives. It is hoped that such a conference will be productive of better understanding and a more thorough co-operation. Meantime, it is most important that actual working conditions should be fully realized by the Canadian people. For five years the world has been wasting the productive capacity of about 50,000,000 men actually engaged in warlike activities. The remainder of the producing population has been to a considerable extent occupied in producing munitions and instruments of destruction. Millions of men must now resume the normal activities of peace. The business of the world has been completely disorganized, and a long period will probably elapse before it can be completely re-established. After the present period of inflation has passed, Canada, in common with other countries, probably will face a period of depression.

"To meet the possible imminence of such conditions, the government has pledged the credit of the country to a very large extent in order to provide employment for the gallant men returning to our shores from war service, and for those engaged in war industries which now have ceased. Many employers of labor have undertaken work at little or no profit in order that their lines of industry might afford every possible opportunity for employment. Up to the present such employment has been fairly abundant, but this condition may not continue indefinitely. Efforts to provide employment will obviously be of little avail if the energy of the country is exhausted in lockouts or strikes occasioned by differences which ought to be settled by peaceful methods."

ENGINEERING INSTITUTE ELECTIONS

AT a meeting of the Engineering Institute of Canada, held August 19th in Montreal, the following elections and transfers were announced:—

Members.—T. J. Locke, Shelburne, N.S.; F. D. Reid, Cobalt, Ont.; Sven Svenningson, Montreal.

Associate members.—J. N. Anderson, Vancouver; C. L. Archibald, St. John, N.B.; G. W. Beresford, Ottawa; H. M. Bigwood, Victoria; R. E. Buckley, Niagara Falls, Ont.; M. A. Burbank, Winnipeg; W. R. Campbell, Campbellton, N.B.; W. B. Crombie, Niagara Falls, Ont.; F. M. Dawson, Westmount, P.Q.; C. H. Ellison, Firdale, Man.; C. C. Elliott. Brooks, Alta.; J. L. Franzen, Medicine Hat, Alta.; R. P. Freeman, Halifax; S. R. Frost, Niagara Falls, Ont.; L. L. Gisborne, Niagara Falls, Ont.; William Harland, Toronto; T. L. Hughson, Niagara Falls, Ont.; W. A. Janssen, Montreal; G. H. Lowry, Niagara Falls, Ont.; W. J. MacKenzie, Vancouver; J. G. MacLaurin, Sault Ste. Marie, Ont.; E. S Malloch, Ottawa; Norman Malloch, Niagara Falls, Ont.; J. B. McAndrew, St. Catharines, Ont.; Lyle McCoy, Montreal West, P.Q.; T. S. Mills, Ottawa; W. G. Montgomery, Peterboro, Ont.; R. C. Morgan, St. Catharines, Ont.; J. B. Petrie. Wabana, Nfld.; G. M. Ponton, Ottawa; O. W. Ross, St. Catharines, Ont.; H. R. Silcox, Toronto; Stewart Troop, Moncton, N.B.; R. S. Trowsdale, Calgary, Alta.; E. O. Way, Ottawa.

Juniors.—Claude Bradley, Calgary, Alta.; A. W. Crawford, Hamilton; D. B. Gardner, Toronto; N. G. McDonald, Niagara Falls, Ont.; C. S. MacLean, Halifax; W. B. Pennock, Ottawa; J. H. Ryan, Halifax; F. B. Young, St. John, N.B.

Associates.—J. F. Block, Calgary, Alta.

Transferred, associate members to members.—J. R. Cockburn, Toronto; G. H. Ferguson, Ottawa; J. F. Greene, Winnipeg; A. R. Holmes, Toronto; I. H. Nevitt, Toronto; H. R. Miles, Lethbridge, Alta.; G. K. McDougall, Montreal; D B. McLay, Vancouver; A. R. Sprenger, Montreal.

Transferred, juniors to associate members.—W. E. Blue, Ottawa; J. W. Ford, Niagara Falls, Ont.; M. H. French, Calgary, Alta.; F. I. C. Goodman, Halifax; A. W. Gregory, St. Stephen, N.B.; R. B. Harkness, Toronto; W. W. Hay, Rogers, Mich.; B. B. Hogarth, Ottawa; R. G. Lye, Toronto; J. A. MacGillivray, Winnipeg; R. C. MacLachlan, St. Catharines, Ont.; H. M. Morrow, Montreal; F. O'B. Nehin, Montreal; J. H. Norris, Montreal; J. B. Shaw, Victoria; J. C. Stewart, Ottawa; Norman Wilson, Ottawa.

Transferred, students to associate members.—J. E. Barcelo, Montreal; E. R. Marien, Quebec.

Transferred, students to juniors.—Theodore Dery, Rimouski, P.Q.; R. C. Ward, Toronto.

At Big Eddy, on the Spanish river, Algoma District, Ont., the International Nickel Co.'s conservation dam, now being constructed, will raise the level of the river 100 ft., and will create a lake with an area of 15 sq. mi. Combined with the storage in the upper third of the Spanish river watershed, it will increase the minimum flow to over 1,800 c.f.s., or almost three times the natural low-water flow.

The New South Wales government intends to proceed immediately with a scheme for a large hydro-electric development, says the weekly bulletin of the Department of Trade and Commerce of Canada. Complete plans have been prepared for two independent schemes, the estimated cost of which is about a million dollars. Of this amount it is expected that half will be spent during the next twelve months. Although there is an ample supply of water power at various points throughout the state, it has not previously been developed and all power at present is derived from coal. When the plans and specifications for the proposed schemes are ready, they will be forwarded to the Department of Trade and Commerce at Ottawa for the convenience of Canadian manufacturers who may wish to tender on some of the equipment.

ECONOMIES OF REINFORCED CONCRETE WALLS FOR UNCOVERED RESERVOIRS*

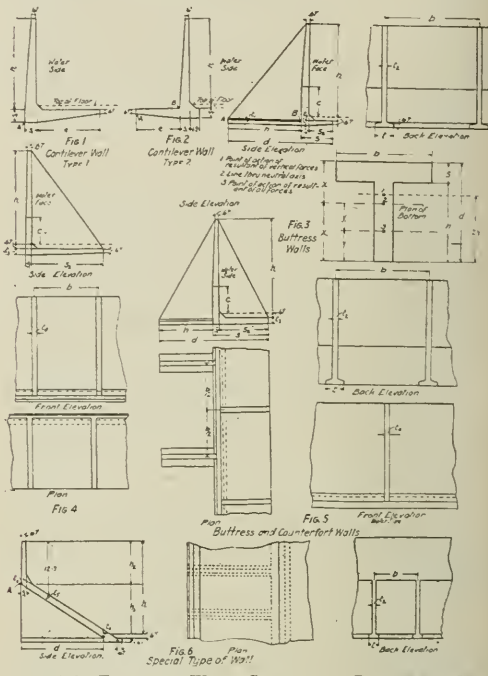
By H. E. Babbitt
Associate in Municipal and Sanitary Engineering, University of Illinois

IN the design of a reinforced concrete wall for an uncovered reservoir the choice of the type of wall is dependent mainly upon economy. The determination of the most economical wall for any particular conditions can be made by designing walls of various types to fulfill the conditions and making a detailed estimate of cost from these designs. Such designs have been made for walls varying in height from 5 to 30 ft., either with or without earth backing. The types of walls studied are shown in Figs. 1 to 6 inclusive. The least volume of concrete per foot of length of these walls for different heights is shown in Figs. 7 and 8. The relative economy of the different types of walls is indicated by the relative amount of concrete in the different types. The difference in the volume of concrete and therefore the economy of the "special" type of wall, compared with the cantilever wall, is striking.

Although the cost of reinforced concrete walls is not directly proportional to the volume of concrete, for any two walls of the same height and with the same loading, the relative cost is approximately as the volume of concrete. The amount of steel is approximately proportional to the volume of the wall. The cost of the form work is dependent more on the type of wall than upon the volume of concrete. Since the amount of form work on the "special" wall is somewhat greater than for the cantilever wall, the apparent saving by the use of the "special" type is somewhat reduced, but the relative economies of the different types is unaffected.

These designs were based on a factor of safety against overturning of 2. The working strength of steel was taken as 16,000 lbs. per sq. in., and of concrete as 650 lbs. per sq. in. No section less than 8 in. thick was used. The greatest intensity of foundation pressure was 6,000 lbs. per sq. ft. The "active" earth backing was assumed to act as a liquid weighing 20 lbs. per cu. ft. Although these assumptions may not be in accord with all conditions of design, a difference in the unit stresses, thicknesses, etc., will affect all types of wall alike and will not affect the relative economy.

In making the designs of these walls the relative economy of various details was developed. In the cantilever wall the economical length of the footing is shown in Fig. 9. For the buttress walls, the economical buttress spacing, the best details of the buttresses, and the effect on the volume of the wall by a change in the buttress spacing are shown in Figs. 10 and 11. Similar details are shown for the other



FIGS. 1-6—TYPES OF WALL STUDIED TO DETERMINE MOST ECONOMICAL DESIGN

*From "Engineering and Contracting," Chicago.

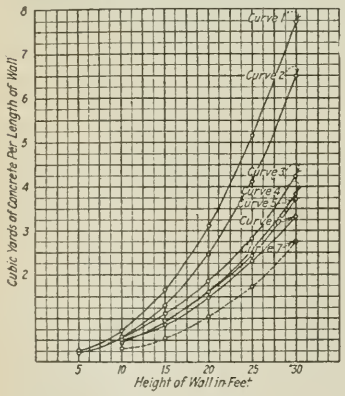


FIG. 7

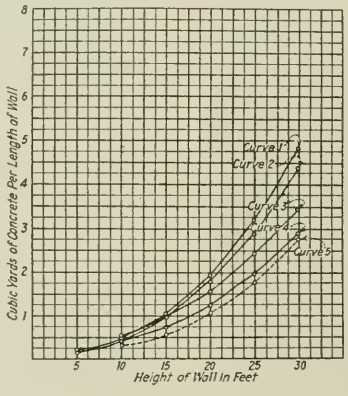


FIG. 8

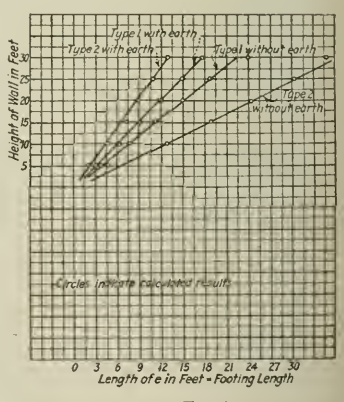

Type 1 with earth
Type 2 with earth
Type 1 without earth
Type 2 without earth
Circles indicate calculated results
Height of Wall in Feet
Length of e in Feet - Footing Length

FIG. 9

FIG. 7—AMOUNT OF CONCRETE IN DIFFERENT TYPES OF WALLS WITHOUT EARTH BACKING: Curve 1, Cantilever Wall, type 2; Curve 2, Cantilever Wall, Type 1; Curve 3, Counterfort Wall; Curve 4, Buttress Wall; Curve 5, Buttress and Counterfort Wall; Curve 6, Special Type of Wall; Curve 7, Special Type of Wall Minus the Quantity of Concrete in a Floor 0.67 Ft. Thick and the Same Width as the Base of the Wall. FIG. 8—AMOUNT OF CONCRETE IN DIFFERENT TYPES OF WALLS WITH EARTH BACKING: Curve 1, Cantilever Wall, Type 1; Curve 2, Cantilever Wall, Type 2; Curve 3, Counterfort Wall; Curve 4, Buttress Wall; Curve 5, Special Type of Wall Without Earth Backing Minus the Quantity of Concrete in a Floor 0.67 Ft. Thick and the Same Width as the Base of the Wall. FIG. 9—FOOTING LENGTHS FOR CANTILEVER WALLS: Circles Indicate Calculated Results.

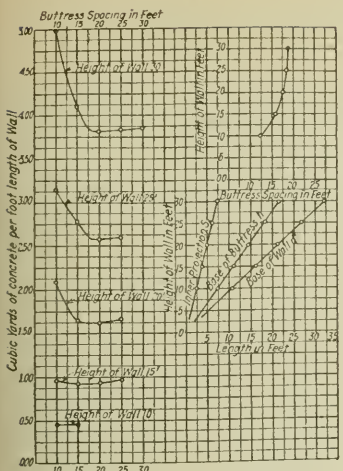

Buttress Spacing in Feet
Height of Wall 30'
Height of Wall 25'
Height of Wall 20'
Height of Wall 15'
Height of Wall 10'
Cubic Yards of Concrete per Foot Length of Wall
Length in Feet
Buttress Spacing in Ft.
Base of Wall in Ft.
Thickness of Buttress
Height of Wall in Feet

FIG. 10—ECONOMIES OF DETAILS OF BUTTRESS WALLS WITHOUT EARTH BACKING

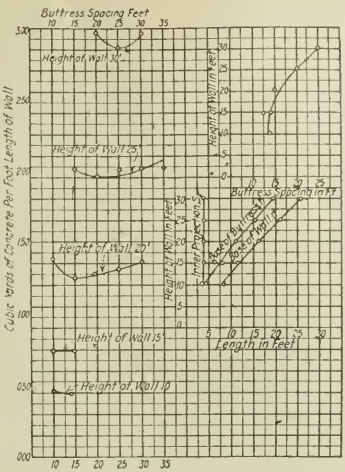

Buttress Spacing Feet
Height of Wall 30'
Height of Wall 25'
Height of Wall 20'
Height of Wall 15'
Height of Wall 10'
Cubic Yards of Concrete Per Foot Length of Wall
Length in Feet
Buttress Spacing in Ft.
Base of Wall in Ft.
Height of Wall in Feet

FIG. 11—ECONOMIES OF DETAILS OF BUTTRESS WALLS WITH EARTH BACKING

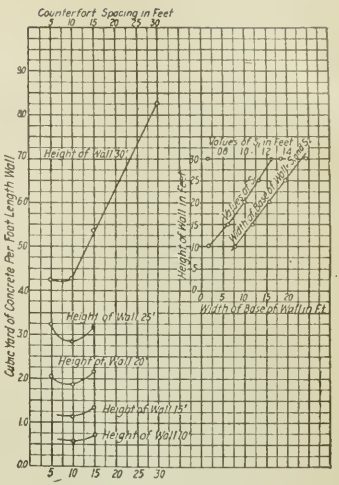

Counterfort Spacing in Feet
Height of Wall 30'
Height of Wall 25'
Height of Wall 20'
Height of Wall 15'
Height of Wall 10'
Cubic Yards of Concrete Per Foot Length Wall
Width of Base of Wall in Ft.
Height of Wall in Feet

FIG. 12—ECONOMIES OF DETAILS OF COUNTERFORT WALLS WITHOUT EARTH BACKING

types of walls in Figs. 12 to 15.

In determining the volume of concrete in the walls the resisting moment against overturning of all portions of the wall was expressed in terms of as few unknown dimensions as possible. The resisting moment was equated to twice the overturning moment. When it was not possible to express the resisting moment in terms of only one dimension, all but one dimension were assumed and the unknown dimension solved from the equation. With all dimensions known the determination of the volume of the wall was a matter of solid geometry. New values of the assumed dimensions were tried until the least volume of concrete for the given height of the wall was found. It was in the process of such computations that the economical dimensions of the various details were found.

The expressions for the dimensions of various portions of the walls were determined either analytically or by trial in such a manner as to make possible the expression of the resisting moment in but few unknown terms. For certain details the economical dimension is that dimension which will give the least amount of material commensurate with the load which is to be supported. In other details the economical dimension is not a function of the load. Those dimensions which depend almost directly on the load were determined analytically, whereas those dimensions which are not direct functions of the load were determined by a method of trial. The following is a summary of the formulas for the details of all of the walls. In addition to the notation on the figures the ordinary notation used in reinforced concrete has been used except that S'_1 represents the effective depth of a beam and S_1 represents the actual depth.

Cantilever Walls. Types 1 and 2, with or without earth backing. Figs. 1 and 2:—

$$S_1 = M^{1/2}/100 \quad \ldots\ldots (1)$$

Buttress Walls without earth backing. Fig. 3.

$$C = [b(b^2+20h_1^2)^{1/2}-b^2]/10h_1 \quad \ldots\ldots (2)$$

$$S_1 = ch_1^{1/2}/18 \quad \ldots\ldots (3)$$

$$S_1 = [b(h_1-c)^{1/2}]/40 \quad \ldots\ldots (4)$$

$$S_1 = [b(b^2+20h_1^2)^{1/2}-b^2]/180h_1^{1/2} \quad \ldots\ldots (5)$$

$$S_2 = h_1/4 \quad \ldots\ldots (6)$$

with limit of—

$$S_2 = 18S_1/h_1^{1/2} \quad \ldots\ldots (7)$$

Spacing of Counterforts and Buttresses closely 15 ft. for all heights of walls between 15 and 30 ft. high.

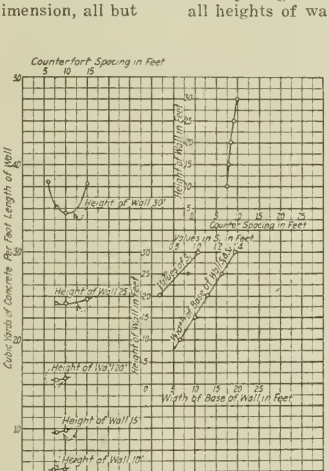

Counterfort Spacing in Feet
Height of Wall 30'
Height of Wall 25'
Height of Wall 20'
Height of Wall 15'
Height of Wall 10'
Cubic Yards of Concrete Per Foot Length of Wall
Width of Base of Wall in Feet
Counterfort Spacing in Feet
Values of S_1 in Feet
Values of S_2 in Feet
Height of Wall in Feet

FIG. 13—ECONOMIES OF DETAILS OF COUNTERFORT WALLS WITH EARTH BACKING

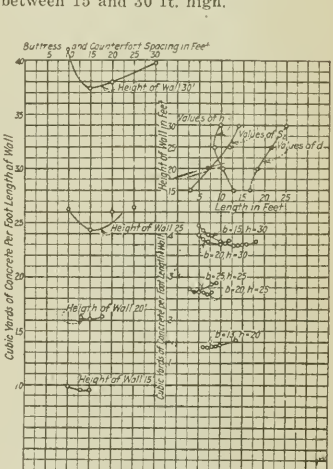

Buttress and Counterfort Spacing in Feet
Height of Wall 30'
Height of Wall 25'
Height of Wall 20'
Height of Wall 15'
Cubic Yards of Concrete per Foot Length of Wall
Length in Feet
Length of S_2 in Feet
Values of S_1 in Feet
Values of S_2 in Feet
Values of h_1 in Feet
b=15 h=30
b=20 h=30
b=25 h=25
b=20 h=25
b=15 h=20

FIG. 14—ECONOMIES OF DETAILS OF BUTTRESS AND COUNTERFORT WALLS WITHOUT EARTH BACKING

$$t = 0.003h_1^2+0.05b+1.5 \quad \ldots\ldots (8)$$

$$t_1 = 0.71(t-t_2)/2, \text{ or approximately } 0.3t \quad \ldots\ldots (9)$$

$$t_2 = h_1/15 \quad \ldots\ldots (10)$$

$$t_3 = S_2h_1/18 \quad \ldots\ldots (11)$$

Buttress Walls with earth backing. Fig. 3:—

C = same as Equation 2.

$$S_1 = ch_1^{1/2}/22 \quad \ldots\ldots (12)$$

$$S_1 = b(h_1-c)/50 \quad \ldots\ldots (13)$$

$S_1 = [b(b^2+20h_1^2)^{1/2}-b^2]/220h_1^{1/2}$ .....(14)
$S_2 = 4$ .....(15)
$t = 0.004h_1^{3/2}b^{1/2}1.5$ .....(16)
$t_1 = 0.3t$ .....(9)
$t_2 = h_1/15$ .....(10)
$t_3 = h_1/4.5$ .....(17)

Counterfort Walls without earth backing. Fig. 4: —
C = same as Equation 2.
S_1 = same as Equations 3, 4 and 5.
$t_3 = bh_1^{1/2}/40$ .....(18)
$t_4 = (h_1+60)/90$ .....(19)

Counterfort Walls with earth backing. Fig. 4:—
C = same as Equation 2.
S_1 = same as Equations 12, 13 and 14.
t_3 = same as Equation 18.
t_4 = same as Equation 19.

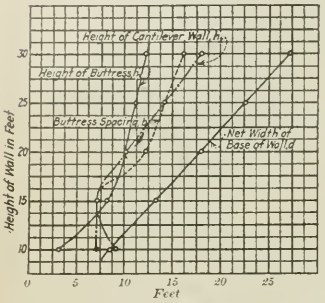

Height of Cantilever Wall, h1
Height of Buttress, h
Buttress Spacing, d
Net Width of Base of Wall, d
Height of Wall in Feet
Feet

FIG. 15—ECONOMIES OF DETAILS OF SPECIAL TYPE OF WALL WITHOUT EARTH BACKING

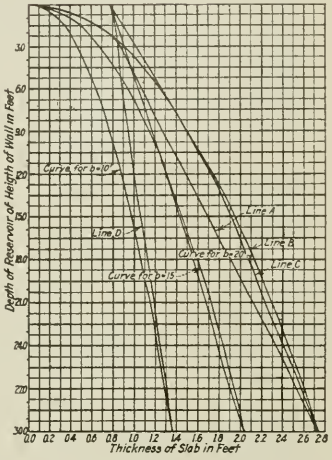


FIG. 16—GRAPHICAL SOLUTION OF SLAB THICKNESS FOR SPECIAL TYPE OF WALL*

Buttress and Counterfort Walls without earth backing. Fig. 5:—
$C = [b(b^2+8h_1^2)^{1/2}-b^2]/40h_1$ .....(20)
$S_1 = ch_1^{1/2}/18$ .....(21)
$S_2 = b(h_1-c)^{1/2}/80$ .....(22)
$S_3 = [b(b^2+80h_1^2)^{1/2}-b^2]/720h_1^{1/2}$ .....(23)
t_1 = same as Equation 9.
t_2 = same as Equation 10.
t_3 = same as Equation 18.
$t_4 = (h_1+6)/24$ .....(24)

Special Type of wall without earth backing. Fig. 6:—
$S_1 = h_2^{3/2}/31$ .....(25)
$t = 1.5$ .....(26)
$t_2 = h_2/15$ .....(27)
$t_1 = 0.67$ .....(28)
t_2, t_4 and t_3 determined graphically from Fig. 16.

The analytical expressions taken together with the graphical representations show the economical dimensions of every portion of the types of wall studied. The results show that for a wall with earth backing a buttress type is the cheapest unless the gain of the floor by the use of the "special" type is taken into account. For walls without earth backing the "special" type is the most economical, regardless of consideration of the saving in the floor area.

*The curves of Fig. 16 represent correct thickness of slab in accordance with the expression $t = bh^{1/2}/40$. Straight lines represent approximate solutions as used.

G. T. Milne, of Montreal, H.M. Senior Trade Commissioner for Canada and Newfoundland, is being transferred to Cuba as commercial secretary to the British legation in Havana.

RECOMMENDED PRACTICE OF MISSISSIPPI VALLEY STATE HIGHWAY DEPARTMENTS FOR CONCRETE ROAD CONSTRUCTION

AT a conference of the Mississippi Valley Association of State Highway Departments, held to consider questions relating to rural concrete road construction, the following "recommended practice" was adopted:—

Proportions.—One-course road: The concrete for a one-course pavement that is to be machine finished should be mixed in the following proportions: 1 sack of cement, 2 cu. ft. of sand and 4 cu. ft. of coarse aggregate. For work that is to be hand finished the proportions should be 1 sack of cement, 2 cu. ft. of fine aggregate and 3½ cu. ft. of coarse aggregate.

Two-course road: The proportions of the concrete for a two-course pavement should be as follows: For the lower course, 1 sack of cement, 2 cu. ft. of fine aggregate and 4 cu. ft. of coarse aggregate.

The proportions for the wearing course should be 1 sack of cement, 2 cu. ft. of fine aggregate and 3½ cu. ft. of the coarse aggregate prescribed for the wearing course of the two-course pavements.

Quantity of Water: It is recommended that extreme care be employed in proportioning the mixture as regards water content, and that this fact be checked by the slump test as follows: For the test, 6 by 12 in. cylinders should be tamped full of the concrete as mixed and the cylinder immediately removed. For work that is to be finished by hand, the slump of the concrete upon removing the cylinder should not exceed 6 in. and for work that is to be machine finished the slump should not exceed 2 in.

Thickness.—The thickness should be not less than 7 in. at the sides nor 8 in. at the centre for two-track roads up to 20 ft. in width. The thickness for single-track roads should be not less than 7 in. at any point.

Widths.—It is inadvisable to build concrete roads less than 18 ft. in width. Where a single-track road must be built it should be made 9 ft. in width and the 9 ft. should be centred on the centre line. Pavements with widths between 10 ft. and 16 ft. should not be built.

The width of grade to be traveled should be not less than 24 ft. for any width of pavement and the minimum over-all width of shoulders should be at least 8 ft. more than the pavement width.

Crown.—The crown should be a total of 1 in. for two-track roads not exceeding 20 ft. in width. If on centre line the crown for single-track roads should be ½ in. If placed with one edge on the centre line the surface should be sloped all one way with a total slope of 1 in.

Alignment.—No radius should be less than 200 ft. on centre line of turns.

Whitening Turns.—On all turns the centre line of the road should be marked by a white strip 8 in. wide.

Superelevation of Curves.—Except when drainage condition may prevent, the grade of the original centre line before widening is to be maintained where pavement is superelevated. The crown of the surface is to be flat where pavement is superelevated.

Grades.—Concrete pavements can be successfully constructed on any maximum grade likely to prove best from general economic consideration. In the middle west maximum grades exceeding 6 to 8% should not be adopted under ordinary circumstances.

Considering the permanency of concrete surfacing a greater expenditure of money is justified in eliminating frequent and minor breaks or changes in grade than is the case with a less permanent type of road.

Vertical curves on steep grades should be sufficiently long to give an unobstructed view of at least 250 ft.

Subgrade.—It is recommended that if possible the subgrade for a concrete pavement be not trenched out and that it be kept higher than the berms, so as to provide drainage directly to the side ditches.

Very careful attention should be given to the rolling of the subgrade. It is recommended that a macadam type of roller be used, weighing not less than 10 tons. If the rolling at any time causes the subgrade to become wavy, the rolling should be stopped immediately over the wavy parts, and the soft material investigated. In clays this is almost always due to moisture and unless it is possible for it to dry out by the sun and wind without delaying the work, it should be removed and replaced with dry clay or other suitable material that can be rolled in a satisfactory manner. If any depressions develop they should be filled with acceptable material as the rolling progresses. Sand and sandy soils require a minimum amount of rolling.

It is recommended that the rough grading be completed very closely to the intended cross section of the subgrade and to the full width of the shoulders. Avoid shallow filling without plowing. Avoid filling narrow, deep ruts without plowing and disking. The finished subgrade immediately ahead of the concrete should be corrected to proper cross section, using a template.

Where the method of depositing the aggregates on the subgrade is followed, the subgrade should be completed fully in sections not exceeding 600 ft. in length immediately before the aggregates are deposited. The surface should be brought to true cross section, using a template or other acceptable method. The roller should be kept in constant operation while the aggregate is being delivered. Any ruts or irregularities caused by the handling of the aggregates should be filled up and thoroughly tamped. Wherever possible, hauling over finished subgrade with teams or motor trucks should be avoided.

Where necessary, to avoid formation of an objectionable layer of dust, the subgrade should be sprinkled in advance of placing materials.

Mixer.—The mixer should be of a standard paving type having a capacity of at least 2-bag batch, commonly known as size No. 14.

The mixer should be equipped with a boom and bucket or some other mechanical device that will deliver concrete of a proper consistency, also with an automatic timing device and a device that will accurately measure the water for each batch.

Water Supply.—In addition to the general recommendation of the American Concrete Institute recommended practice, the water supply should be free from injurious substances, duplicate pumping machinery should be provided, booster pumps should be provided on long pipe lines, and in all pipe lines there should be provided unions at intervals not greater than 1,000 ft. Tees for supply water to the mixer and for sprinkling should be placed at intervals not greater than 100 ft.

Time of Mixing.—Materials should be mixed at least one minute after the entire batch is in the drum. The speed of the drum should be not less than 12 revolutions per minute.

Side Forms.—Steel side forms should be used and after the forms are set the joints should be inspected carefully, using a straight edge to insure proper horizontal and vertical alignment.

Placing Concrete.—The operation of depositing, spreading, and finishing the concrete should be as nearly continuous as possible for the full width and thickness of the pavement. When delays, of sufficient length to permit the concrete deposited to attain initial set, are necessary a suitable header should be placed at right angles to the road and the concrete finished to this header to true elevation and cross-section.

The concrete may be transported from the mixer to place on the subgrade in any convenient manner which avoids the segregation of materials. Any device or method of operation which tends to segregate the materials in such a manner that later operations do not completely eliminate such segregation should not be permitted.

Placing Concrete in Cold Weather.—Every effort should be made to arrange for closing concrete road work in the fall or on about such date as the weather bureau reports for the locality for the past ten years indicate the probability of temperatures materially below the freezing point. If circumstances necessitate continuing work for a short period after freezing weather is likely to occur, precautions should be observed which will insure positively that the concrete may not become frozen under the most extreme conditions of temperature for the period, as indicated by weather reports for the past ten years. Concrete should be protected absolutely from freezing by suitable means for at least seven days after placing.

Expansion Joints.—Expansion joints should be used only in specific cases, such as junctions between the pavement and other fixed objects.

Expansion joints when used should consist of either high grade wool felt or a fibrous material combined with a coal tar or asphalt compound. The filler should contain, by weight, not more than 8% of mineral matter and not less than 5% nor more than 25% of fibre.

Contraction Joints.—Contraction joints should not be used. Construction joints should be made at the end of each day's work or when mixing is stopped for any reason longer than one hour.

Reinforcement.—For pavements up to 18 ft. in width with good foundation the value of any practicable amount of reinforcement is questionable.

For pavements over 18 ft., and especially where foundations are not thoroughly satisfactory, reinforcements, mainly in a transverse direction, may be used to advantage.

Where reinforcement is used it should be wire mesh or separate bar reinforcement, not less than 40 lbs. per 100 sq. ft., and the proportion of transverse to longitudinal steel should be not less than 3 to 1.

The reinforcing should be placed not less than 2 in. from the finished surface of the pavement. Adjacent widths of the fabric should be lapped not less than 4 in. when the lap is made perpendicular to the centre line of the pavement and not less than 1 ft. when the lap is parallel to the centre line.

Machine Finish.—When mixtures of relatively dry consistency are used, such as those necessary to secure maximum strength as far as such strength is determined by the water content, mechanical strikers and tampers should be used. Machines should be so constructed and operated that they strike off and thoroughly tamp the concrete. They should be so constructed that they may be readily operated over the same area repeatedly. Machines to serve the purposes above indicated should be subject to the approval of the engineer. The mechanical device or devices used should be so made and operated as to leave the finished slab true to grade, crown, and surface and absolutely free from porous places.

Hand Tamping.—If a mechanical finisher is not used and the consistency of the concrete is to be as above described, after spreading the concrete should be thoroughly hand tamped by means of a tamper of the nature of a strike board operated by one or two men stationed at each end of the tamper on opposite sides of the roadway. Hand tamping should be vigorous and sufficient to consolidate the concrete in such a manner as to close all voids. The hand tamper should be followed by a final strike board and all operations carried on in such a manner as to leave the surface behind the final strike board true to grade, crown, and surface, and absolutely free from porous places.

Roller and Belt Finish.—If a medium consistency is used, the concrete should be spread, agitated, and tamped in such a manner as to insure positively the avoidance of stone pockets or porous places. It should be struck off true to grade, crown, and surface. It should then be rolled by a light hand roller of approved design operated in such a manner as to remove the surplus water and leave the surface true to grade and crown.

When hand methods of striking and tamping are used the final finishing should be executed by means of an approved belt operated in such a manner as to leave the pavement true to crown and free from waves, ridges, depressions, or other irregularities and with a uniform mat surface.

Curing.—As soon after finishing as may be possible, without marring the surface, the slab should be covered with

canvas. When the concrete has set sufficiently to obviate the possibility of marring, and where local conditions permit, suitable longitudinal and transvere dikes should be built and water supplied to cover the surface of the concrete to a uniform depth of 2 in. The water should be maintained on the surface for not less than 14 days. Under conditions where it is impractical to adopt the ponding method of curing, the surface of the concrete should be covered with not less than 2 in. of earth and kept moist for at least 14 days by wetting not less frequently than intervals of 12 hours.

Traffic should not be permitted to use the pavement in less than 21 days if the pavement has been subject to favorable curing conditions; nor in less than 40 days if subject to unfavorable curing conditions.

Traffic should not be permitted to use the pavement for a period of at least three days after removal of the water or earth covering.

MOOSE JAW WATER SUPPLY*

Commissioner Mackie Favors Plan for a 24-inch Continuous Wood Stave Pipe Line from Caron Head Works to the Saskatchewan River at a Cost of $1,630,000

AT a recent meeting held in Moose Jaw, Sask., at which representatives of nearly every Moose Jaw organization were present, steps were taken and a committee was appointed to take up immediately the question of the Saskatchewan River water scheme for Moose Jaw, as outlined by City Engineer G. D. Mackie, which, in the unanimous opinion of the meeting, was the only solution for the water problem that now exists.

Commissioner Mackie, although he mentioned several alternatives in his address, favored, for financial reasons, the plan for a 24 in. continuous wood stave pipe line from the Caron head-works to the Saskatchewan River, a distance of between 54 and 70 miles, depending on the route selected, which can be constructed and in operation, if started at once, by the end of this year, at an outside cost of $1,630,000, with an effect on the mill rate of from 5 to 7 mills, depending on the city assessment, if the city pays the entire cost, or of one mill only if it is found possible to secure aid from other sources as suggested.

Committee Appointed

The meeting, which was called under the auspices of the Board of Trade, at the suggestion of President George A. Maybee, resolved itself into a Citizens' Committee, with Mayor Hamilton as chairman. Mr. Mackie was then called upon to make his address, and following that, a short discussion which occurred was brought to a close by a motion stated by William Grayson and seconded by George C. Ingram, that the men named below be appointed a committee to go immediately into the engineering, financial and legislative problems that surround the scheme, and report back to a meeting of citizens to be held in the near future.

Mr. Grayson named the following members of the committee: Mayor S. A. Hamilton, City Engineer Commissioner G. D. Mackie, Alderman W. G. Ross and W. D. McIntyre, President George A. Maybee of the Board of Trade, Arthur Hitchcock, John H. Grayson, ex-Mayor W. W. Davidson, W. Gardner and W. E. Stephenson of the Moose Jaw Trades and Labor Council Executive.

Present Supply

Mr. Mackie, in discussing the water situation, dealt with the present water supply of the city, pointing out the fact that the maximum summer flow is now one million gallons per day, and that the maximum winter flow varies from 800,000 gals. per day to as low as 700,000 gals. per day. The average consumption per head per day in 20 cities of Alberta is 74.5 gals. In ten Saskatchewan towns the average is 47.9 gals. per head per day, and in the Dominion, as a whole, it is 111 gals. per head per day. Moose Jaw's average consumption per head per day is 53 gals.

In dealing with the industrial water consumption of the city, Mr. Mackie stated that in Moose Jaw the industries consumed more water than those in any other city in the province, and that in the months of January, February and March of this year one firm alone consumed 300,000 to 350,000 gals. per day. The water situation as a whole, he said, was that the city had a possible maximum supply of one million gallons per day, and that the average consumption in 1918 was 883,000 gals. per day, and that the industrial consumption had increased from 150,000 gals. per day in 1914, to an average of between 300,000 and 350,000 gals. per day.

High Cost Per Capita

Dealing with the cost of Moose Jaw's water system, the commissioner said that Moose Jaw's water system, if carried out as per his proposed scheme, would be the most expensive per head in the Dominion. To date, the total expenditure on the city's water system is $67.65 per capita. The expenditure to date per head in the Greater Winnipeg water area is $106.63, and Moose Jaw's, if the Saskatchewan River line is built, will be $149.15 per head.

Referring to a previous meeting at which he made the statement that there was sufficient water in Moose Jaw Creek to supply the city's needs for several years to come, Mr. Mackie said that he could only repeat that statement. The average run-off of the creek per year for eight years is seven and one-half billion gallons. Were that scheme gone ahead with, it would be necessary to built a ten billion gallon reservoir, which would hold enough water to supply the present population for three years. The land that would be flooded by such a reservoir would be five thousand acres, and the minimum estimated cost would be $1,250,000, of which amount $450,000 would be required for the pipe line alone. Of that sum $400,000 would have to be spent in the east end of the city, because of the fact that there is not at present any water main system there to connect with the mains large enough to start the distribution within the city of such a large amount of water. In addition, another disadvantage of this proposal is that if the city outgrows the supply that can be secured from the Moose Jaw Creek, the expenditure entailed in construction will be lost, because the next scheme possible of consideration is the Saskatchewan River. If the cost is at all comparable, there is no doubt that the Saskatchewan River scheme is the better of the two.

Mr. Mackie then considered the Saskatchewan River as a source of water supply for Moose Jaw. Mr. Francis, who was the engineer in charge of the Caron water works construction, and who recommended the Caron scheme over the Moose Jaw Creek, although admitting that it was only a tentative solution, did recommended Caron, because it was a distance of 20 miles gained toward the then considered ultimate solution, the Saskatchewan River, while the Moose Jaw did not offer that advantage. Mr. Francis, however, estimated on the Saskatchewan River scheme, and his figure was five million dollars.

Other Schemes Very Costly

Various Dominion government schemes are estimated at between eight and fifteen million dollars. Major McPherson, who proposed to build an open ditch carrying water from Pelican Lake, and through Thunder Creek, estimated his project at $850,000, but the disadvantages of his scheme were that the city would have such a supply available for but seven or eight months of the year, and that in order to secure a million gallons per day it would be necessary to pump between ten and twelve million gallons to take care of evaporation and percolation over the 60-mile open ditch. A flow of but one foot every two seconds could be secured.

Local Supply is Limited

It is possible by further development to augment the city's present supply locally, but the outside estimate made by Mr. Mackie is that 150,000 gallons per day could be thus secured, which amount, in his opinion, is not worth considering. With the stock yards in operation, they with the packing house and the C. P. R. could be expected to consume from

*From the "Western Canada Contractor."

one-half to three-quarters of a million gallons per day next winter.

His Saskatchewan River scheme, he said, included pumping at the river of all the water through a pressure pipe to the height of land, a height of 330 feet, into a two million gallon reservoir, and from there to the Caron headworks through a 24-inch continuous wooden stave pipe line.

Sixty-Mile Pipe Line

The shortest route from Caron to the river is 54 miles and the longest route considered is 70 miles. The short route cannot be used, however, owing to the fact that high ground intervenes between the river and Caron. In Mr. Mackie's opinion it will be necessary to build a pipe line of 60 to 62 miles to get the gravity flow from the height of land at the river to Caron. A survey would have to be made to determine the best route, as every mile of pipe line saved means a saving of $17,000.

In determining the size of pipe to be used for his scheme, Mr. Mackie stated that he started with the consideration of four million gallons per day capacity, an amount larger than the present needs. He therefore proposes a pump at the river sufficient only for the present needs, and to keep the cost as low as possible, has not provided for stand-by pump in the event of break down. This means that it could be figured that the pump at the river would have to be shut down two days per month because of accident, during which time the Caron system would be in a position to supply the city's wants. No filters would be used, it being planned to use the same type of infiltration gallery as in use at Battleford and North Battleford.

Wood-Stave Pipe Cheapest

"The cost of the auxiliaries to such a scheme," said Mr. Mackie, "is mere bagatelle to the cost of the pipe line. There has been a great deal of discussion here on wooden pipe lines, but I intend to advocate a wooden pipe line for financial reasons." He then quoted figures showing that the cost of 24-inch wooden pipe laid in the ground, exclusive of the cost of excavation and back-filling is $2.30 per foot, of steel $5.74 per foot, and cast-iron $10.51 per foot. The cost therefore for 70 miles of wooden pipe would be $850,000; for steel, $2,123,000; and for cast-iron, $3,890,000. In addition there would be a tremendous saving in the tonnage hauling cost, the wood tonnage being about 9,000 tons, steel 15,000 tons, and the cast-iron the heaviest, about 45,000 tons.

The outside cost of the entire scheme for the three types of pipe, wood, steel and cast-iron, were quoted by Mr. Mackie as follows: Wood, $1,630,000; steel, $2,900,000; iron, $5,000,000.

Figuring the life of the wooden pipe line at but fifteen years, he said the saving on the carrying charges would be some $60,000 per year, which would amount in fifteen years to a sum sufficient to enable the city to replace the wooden pipe line.

Total Cost $1,630,000

The cost of the system with 24-inch wood pipe, would be as follows:—

Diesel engine and pump at river	$ 148,000..
Force pipe to height of land, 330 ft.	65,000
2 million gallon reservoir at river	65,000
Pipe line laid	1,184,925
Damages	88,630
Engineering and contingencies	78,445
Total	$1,630,000

In further describing the type of pipe line recommended, Mr. Mackie declared that it is different from the old type in that it is of the continuous stave type, thus avoiding joints and the leakage which occurred and always will occur in such joints. In addition, the bands of the pipe, instead of being continuous, are individual, so that when one break occurs the whole pipe will not leak, as in the case of the Snowdy Spring line, for instance. He would lay the pipe but 6 feet in the ground, sufficient only to protect it from rodents, etc., and to keep it below ground. That depth is sufficient to protect from frost at the velocity the water would travel through it. The El Paso Railway was faced with a similar situation for water, he said, and decided on wood because of the prohibitive cost of iron or steel. They now have 116 miles of this pipe in operation, and it is giving satisfaction.

The present Caron line has a capacity for 2,400,000 gals. per day. This can be increased to a maximum of 3,960,000 gals. per day, by different placing of pumps, and different methods of taking water from new to old pipe line, either through Caron reservoir, or direct to the old pipe line. The minimum winter flow of the Saskatchewan River at Saskatoon is 600 million gals. per day.

The Financial Problem

In conclusion, Mr. Mackie dealt with the financial aspect of the scheme, saying that while it did not present any engineering difficulties, it does present financial difficulties.

He presupposes the issue of 20-year debentures, assuming that the life of the wooden pipe is fifteen years. In the life of the pipe he plans to set aside a sum of $400,000, which, after the debentures had been retired, could be used as a nest egg for the replacing of the line. The carrying charges on this basis, at 5½% would be as follows: Interest charges, $89,000 per year; sinking fund payments, $54,000, and depreciation, $20,000 per year; a total of $163,000 per year, which, added to the carrying charges of the present water works, would make the carrying charges for the entire system $318,000 per year. Figuring on the sale of half a million gallons per day more water than at present, the annual deficit on water would be $146,000 per year, which on the present assessment would cost the citizens 7 mills additional tax rate.

On the 1913 assessment, he said, this could be handled by 3 mills additional levy.

Mr. Mackie next dealt with the city's borrowing power, which at the present time is $400,000 in round figures. His suggestions for increasing it to bring down the mill rate necessary to handle the water system proposed were several. One method was by increasing the improvement assessment to 60% instead of the present 45%. Another was to revert to the old business tax assessment instead of the present business license. A third was to increase the present land assessment by four million dollars. All three of these suggestions, if adopted, would bring the city assessment up to $31,000,000 and would make it possible to carry the proposed and present water systems for 5 mills instead of 7 mills.

The Canadian Board of Commerce has now been constituted and will shortly be available for such complaints as may be laid before it. It will act under the Combines and Fair Prices Act, and is given power to institute investigations on its own motion or at the request of any responsible parties who bring subjects to its notice. The chairman states that the procedure will be of an informal character.

Perhaps the largest reforestation scheme ever undertaken in Canada is being carried out in Quebec this year. The Laurentide Co., of Grand'mère, is planting over 1,000,000 seedlings, mostly Norway spruce, with some white Scotch and jack pine and balsam. The Riordon Co., of St. Jovite, is also planting about 750,000 seedlings. Much the greater number of the seedlings used are imported from forest nurseries in the United States.

In a recent address before members of the Advertising Club, of Baltimore, Md., H. D. Hubbard, of Washington, D.C., secretary to the U.S. Government Bureau of Standards, made an earnest plea for the adoption of metric units of measurement in the United States and Canada. Mr. Hubbard pointed out that during the war many United States and Canadian manufacturers were forced to use the metric system in the manufacture of guns and other ordnance, and two principal works had to use it in the building of locomotives. If the work on the blue prints for these locomotives had to be done in feet and inches, Mr. Hubbard said, the locomotives would never have been built on this continent. He further said that by refusing to adopt the metric units, United States and Canada are as far behind in the matter of proper standards as was China, but that China has now adopted the metric system.

STRESSES IN CONCRETE ROAD SLABS FROM WHEELS OF HEAVY TRUCKS

At the present time it is impossible to calculate the proper thickness of a concrete road slab with much certainty. It is known that a thicker slab is required where the subgrade is soft than where it offers a good bearing, and that heavy loads require a thicker supporting slab than light loads; how much thicker, however, has not been determined. The stress in a slab depends upon the bending moment produced in the slab, and this in turn is dependent largely upon the distribution of pressure over the subgrade. It is recognized that ununiform subgrade pressures are due to causes other than the heavy traffic loads carried by the slabs. An investigation to discover how the road slab is stressed directly under the wheels of heavy trucks and to determine whether this stress is apt to be a governing influence in the design of the slab, has been initiated by the United States Bureau of Public Roads. This test is one of a series of investigations outlined to include an adequate range of the different varieties of subgrades and slab thicknesses. The test was made on the concrete road between Camp Humphreys and Alexandria, Va. The road surfacing at this point is 18 ft. wide, 8 in. thick at the centre, and 6 in. at the sides. A 1:1½:3 gravel concrete was used, having a crushing strength, as determined by 6 by 12 in. cylinders cast in the field at the time the road was laid, of 3,190 lb. per sq. in. The aggregates in the concrete at this point were Potomac River sand and gravel. Here the road runs through a 6-ft. cut and the subgrade in the past has remained rather wet and soft. The soil is composed of a sticky clay, which, when wet, has very low bearing value.

Designed Special Pressure Cells

To measure the pressure distribution, four pressure cells were designed in the Bureau of Public Roads. In order to determine the distribution of pressures under heavy wheel concentrations, a class B standard army truck was loaded with 5 tons of sand. The front wheels and rear wheel of the loaded truck were weighed separately and the axle loads were found to be 5,000 lbs. and 17,000 lbs., respectively.

On February 5th, 1919, a test was made on the Camp Humphreys road with this loaded truck. It was backed 1 ft. at a time up to the central measuring cells. When the rear wheels reached a position directly over the cells, the truck was backed 1 ft. at a time still farther until the front wheels were just over the cells. As a second test the truck was backed with the wheels as close to the side of the road as possible so that they would be made to come directly over the cell placed at the extreme side of the road. During the progress of the preliminary measurements, taken over a period of four months, opportunities offered themselves for obtaining some idea of the effect of light loads on the subgrade pressures, and these are presented in the following table:—

		Ford.	Boiler.	Front army truck.	Rear army truck.
Load on slab ...	[1]200	[1]350	[1]3,680	[1]2,500	[1]8,500
Maximum intensity of pressure	[2]0.2	[2]0.4	[2]3.5	[2]1	[2]6.5
Radius of area of distribution	..	[3]2	[3]5½	[3]3	[3]6

[1]Pounds. [2]Pounds per square inch. [3]Feet.

Summarized Results of Investigation

The results of the investigation are given by A. T. Goldbeck, engineer of tests, U.S. Bureau of Roads, in a report made public recently by the Bureau. The tentative conclusions drawn from this preliminary investigation are as follows:—

1. That a concrete road slab under the action of traffic or perhaps under the influence of frost and different percentages of moisture in the subgrade is continually bending, so that the reaction pressures between the subgrade and slab are neither constant nor uniform in intensity.

2. The reaction pressures due to heavy wheel loads are a maximum directly under the loads and vanish to zero in a comparatively small radius, which partially depends upon the intensity of the load. A heavy wheel load is distributed over a larger radius than a light wheel load. For this particular subgrade, a load of 8,500 lbs. has a radius of distribution of pressure of about 6 ft., most of the pressure, however, being exerted over a radius of about 4 ft.

3. As the concrete slab recovers from its deflection after the passage of a load more readily than the soft subgrade, there is a tendency for the continual deflection of the slab to produce areas having very little or no bearing. If the traffic is concentrated at the centre of the road, as it is on many concrete roads, the continual deflection tends to depress a soft subgrade away from the centre of the slab, which would then be more largely supported at its sides. In extreme instances this might account for some longitudinal cracking in concrete roads.

4. As nearly as can be estimated from the results of this test, the tensile stress in an 8-in. concrete slab directly under an 8,500 lb. wheel load at rest on the road is only 34 lbs. per square inch when the slab is well supported on the subgrade. As the modulus of rupture of 1:1½:3 concrete is about 600 lbs. per square inch, it is seen that this pavement should be able to withstand considerable impact before cracking. Should the concrete arch, over very soft spots, so that there is no support directly under the load, the tensile stress may become very high. Such a condition arises when the sides of the slab are raised by frost action or possibly when the subgrade is worked away from under the slab by continual deflection.

5. It is probable that the tensile stress which results in the slab directly under heavy wheel loads is never very great as long as the slab rests on the subgrade and it is unlikely that the slab design would ever be controlled by this stress.

ONTARIO HYDRO ASKS COMPENSATION

Formal application has been made to the Minister of Finance by the Hydro-Electric Power Commission of Ontario, asking that the Dominion government reimburse it approximately $5,000,000 for the extraordinary war expenditures incurred on unavoidable extensions due to the necessity of providing power on a large scale for the manufacture of munitions and other materials for war purposes in order to meet the demands made by the manufacturers and the power controller. In support of this application the commission has forwarded to Sir Henry Drayton a file containing the voluminous correspondence and orders covering the period when the extensions were made. It is pointed out by the commission that the power controller, under whose orders much of this work had to be undertaken to meet the needs of the munitions manufacturers, had authority only over Ontario. This control was exercised, it is claimed, almost solely over the Hydro-Electric Commission. In such cases as private companies ordered to make extensions, it is said by Sir Adam Beck that they were either reimbursed by the Imperial Munitions Board or the manufacturers whom they supplied.

In making this application to the Dominion government the commission states its belief that the Dominion government will recognize that the financial burden of the war should be borne by the people of the Dominion as a whole, and not by one province or group of municipalities who happened to be in the fortunate position, owing to the existence of cheap hydro-electric power, of contributing so largely to the defence of the Empire by the manufacture of these munitions.

The items in the Commission's bill, which is for $4,902,000, are as follows: $2,500,000 for the extension to the Ontario Power Co.'s plant, which was temporary for war purposes only and will soon be abandoned; $652,000 for duty on equipment for the O.P.C. extension and the Queenston-Chippawa development; and $1,750,000 for increase in cost, compared with normal times, of extensions of transmission lines and equipment on the Niagara system necessitated by the power requirements of the munition manufacturers. Sir Adam Beck points out that in the United States the government has compensated power companies for extraordinary war expenditures.

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MODERN MACHINERY SUPERSEDING LABOR

POWER-DRIVEN machinery is being manufactured with ever-increasing capacities, reducing labor costs (in hours, at least, if not always in dollars, owing to increasing wages) per unit of work done, permitting larger jobs to be completed within the same time, reducing the important item of "interest during construction," and providing the engineer with more powerful weapons with which to overcome obstacles and to harness the forces of nature.

A striking example of the utility of big plant for big work, is the Queenston-Chippawa power canal, the progress of which is described in this issue. The amount of earth and rock being handled by a comparatively small force, constitutes a record previously unknown in the construction world. The daily removal of over 20,000 cu. yds. of earth and rock, in addition to the accomplishment of a great amount of other work such as railroad construction, bridge-building, etc., all with an average daily payroll of considerably less than 2,000 men, is a feat that could not have been performed a few years ago without expenditures for plant that would have been enormously out of proportion to the value of the work being done. This feat has been made possible by the development of economical machines that are giants in comparison with the machines of a decade ago.

The construction undertakings of the past were not large enough, with but few exceptions, to permit of huge investments in construction plant, and in many cases where unusually powerful equipment could have been used, it was not designed owing to the recognized impossibility of finding a market for it after the work had been completed. To-day there is almost invariably a market for all construction equipment that is in good condition, regardless of its size.

The power-shovel manufacturers and the builders of large crushers are, in a great measure, responsible for the improved methods of handling rock, and they predict that within a very short time they will be selling 10-yd. shovels, 84-in. by 120-in. jaw crushers and 84-in. gyratory crushers. On the Queenston-Chippawa job there are 8-yd. shovels and a 60-in. by 84-in. jaw crusher. Since this job was started, 66-in. by 86-in. jaw crushers and 60-in. gyratory crushers have been built and placed in successful operation.

The evolution of huge shovels and crushers has been slow but steady and sure. Sizes of crushers built thirty years ago, and at that time considered large, to-day are not manufactured excepting for laboratory work, as their operation is no longer economical.

ARE YOU AN UNRESPONSIVE CITIZEN?

ONE of the greatest statesmen in the United States, whose name, it is said, cannot be disclosed, recently made the following statement concerning the activities of the United States Engineering Council:—

"Your task is appalling. You have been elected to lead engineers into a political reform. They are the most unresponsive citizens that we have. Your organization has a praiseworthy purpose, but if it were sponsored by almost any other group of reputable men than engineers there would be more promise of success. If your organization succeeds, I believe you will find that it will not be the engineers who have carried through. Their aloofness and indifference in all matters outside of their own professional sphere, are among the unexplainable things in our political life."

This statement, we consider, is a totally unmerited condemnation of engineers as public-spirited citizens. They are not "unresponsive citizens." To the contrary, they are among the hardest-working, most unselfish, modest members of society. Because they do not toot their own horns like professional politicians, those politicians, it seems, are prone to consider them "unresponsive." Had the statesman substituted the words "self-effacing" for the word "unresponsive," his summing-up of the situation would have been far more accurate and truthful—all but the last sentence. The last sentence should read:—

"Their hesitation in participating in matters outside of their own professional sphere is explained by the conditions now existing in our political life, whereby lawyers in high places appoint fellow lawyers to all positions of trust and prominence, almost wholly regardless of the special technical knowledge required for a proper fulfillment of the duties of those positions."

But perhaps the statement doesn't warrant our getting agitated. It is an anonymous statement. The man who made it should sign it and stand behind it, otherwise it must be classed with anonymous letters. The American Association of Engineers has forwarded a circular to all of its members calling their attention to this statement, and apparently attaching great importance to it. The inference made by the association's circular, in describing the statesman as "one of the greatest," is that President Wilson made the statement, because in Washington there is an unwritten law among newspaper men and others that the president must not ever be directly quoted. This rule does not apply to any other statesman. The inference that can thus be taken is undoubtedly unjust to President Wilson, because that great statesman has better sense and a keener insight into all professions than to make the mistake of interpreting the engineer's retiring disposition as indifference or unresponsiveness to the call of public duty, wherever or whenever it may be heard.

The Asphalt Association has decided to open an office in Toronto, and has appointed Capt. Bruce Aldrich as district engineer. Capt. Aldrich has resigned as deputy works commissioner of Baltimore, Md., where he had seven asphalt plants under his jurisdiction. He organized and equipped the municipal laboratory at Baltimore, and supervised the construction of more than 3,000,000 sq. yds. of sheet asphalt and bituminous concrete.

PERSONALS

CAPT. RAY FRASER ARMSTRONG has been elected town manager of Woodstock, N.B., the first town in New Brunswick to adopt this form of municipal government. Capt. Armstrong is a son of R. E. Armstrong, formerly editor of St. Andrew's Beacon. Capt. Armstrong is a graduate of the University of New Brunswick, where he earned the B. Sc. degree, and a post-graduate in engineering of McGill University. He has been an associate member of the Engineering Institute of Canada since April, 1915. Before the war, he served in various engineering capacities in Montreal, Edmonton, Banff, Tofield, Coronation, Vancouver and St. John. He was engineer-superintendent of water works and sewerage at St. John, N.B., when he enlisted in 1916. In France he was transferred to the Canadian Engineers and won his captaincy and the Military Cross in the last big drive.

LT.-COL. H. R. LORDLY, consulting engineer, of Montreal, has been elected a fellow of the Society of Engineers, London, Eng. Col. Lordly is a graduate of Cornell University and holder of the Fuertes medal. He took the 5th Pioneer Battalion overseas in 1916, and also served at the front with the Imperial army. The Society of Engineers is an amalgamation of the former Society of Engineers, established in 1854, and the Civil and Mechanical Engineers' Society, founded 1859. The merger took place in 1910. Under the new charter the membership is limited to one thousand.

ALBERTA INDUSTRIAL CONGRESS

(Continued from page 256)

high. The Baptiste power, 170 miles from Edmonton, might be developed to the extent of 12,000 horse-power, and another site on the Baptiste River would yield 6,000 horse-power. There are numerous other sources but they are for the present too remote to be of practical value.

Water, said Mr. White, is, however, only one source of power and the prevailing impression that it is cheaper than steam power is correct only under certain conditions. Compared with steam power it has the following advantages:—

(1) Cost of operation is usually much lower.

(2) Very few attendants are required in the plant and no fuel is required excepting for heating the building.

On the other hand there are the following disadvantages:—

(1) Usually the cost of development and installation is much higher than with steam power.

(2) The situation of the water power plant is fixed by nature and as a rule a transmission line is required to transmit the electric energy to the user.

(3) The service is less reliable owing to the possibility of (a) injury to the transmission line and (b) lack of power due to unusually low water.

During recent years, owing largely to the introduction of the steam turbine, the capital cost of modern steam plants and of many hydro-electric power developments are coming closer together and some engineers predict that at an early date steam-electric power will be produced at less expense, other things being equal, than hydro-electric energy. Alberta, he said, contains 87 per cent. of the coal in Canada and is, therefore, in an excellent position to produce steam power.

Plea for Scientific Development

Dr. R. D. MacLaurin, professor of chemistry in the University of Saskatchewan, spoke on "A Field for Reconstruction." "During the past five years," he said, "Canada's national debt has rapidly increased until it has reached the sum of $1,950,000,000, incurring interest charges to the amount of $115,000,000. Our adverse balance of trade with the United States in 1918 amounted to $292,000,000, and our exchange rate is 5⅛ per cent. The recommendation by the finance minister of Canada to meet that situation was 'increased production and thrift.' The war made it necessary for Canada to mortgage her resources, human and material, for the purpose of carrying on. The obligations were loyally and willingly assumed, but we are now confronted with the question—How is the liability to be financed? Will 'increased production and thrift' accomplish this?

"For the successful carrying out of a policy formulated for the development of our natural resources, the co-operation of men of scientific attainments is essential. In 1916, in urging the development of our resources, I suggested that provision be made in the case of a research subsidized by the government and leading to a discovery, invention or the improvement of a technical process, protecting the author in the ownership thereof. As government aid had, at least, materially contributed to such discovery, invention or improvement of a technical process, provision should also be made for a royalty to the government on its use for the purpose of maintaining a national research fund.

"The creation by the Alberta government of a ministry of industry, and the calling of this industrial congress by the Industrial Development Association of Alberta, is an outstanding recognition of the value of Alberta's natural resources, and a realization of the urgency for their immediate development.

"The Dominion of Canada ranks second among the nations of the world as regards its potential coal resources, which have been estimated at 1,234,269 million tons, of which 1,059,927 million tons, or 86 per cent. of the total, is possessed by the province of Alberta. Furthermore, the total coal in Great Britain and Ireland, Australia, India, South Africa, New Zealand, Rhodesia, Newfoundland, South Nigeria, British New Borneo, has been estimated at 494,961 million tons; consequently, according to the above figures, Alberta contains more than twice as much coal as Great Britain and her other possessions within the empire."

The speaker then showed how coal had contributed to the industrial development of England, Germany and other countries.

War Interfered with Progress

The closing sessions of the Congress were held in Edmonton on August 15th. The delegates were entertained at a banquet in the Macdonald Hotel given by the Board of Trade, at which A. M. Frith, first vice-president, presided. Short addresses of welcome were given by Mayor Clarke and James Ramsay, M.L.A. An address by Dr. John A. Allen on the mineral resources of Alberta was interesting and instructive. He pointed out that the mineral resources of the province stood second in the matter of basic wealth, the first place going to agriculture. The last few years had seen great strides toward the development of natural resources of Alberta, he asserted, the value of production in 1917 being computed at $16,000,000, and in 1918, $24,000,000. He considered, however, that the vast wealth was yet unknown, and that the north must be looked to for the full determination of the metallic wealth of the west. Here the indications were most favorable. The clay products were so extensive that it has not been possible to develop them. The war caused some hindrance in the matter of production in this regard, for while the value of the products produced in the province in 1912 amounted to one and a half million dollars, at the end of 1917 the output had decreased to half a million.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand or proposed, contracts awarded, changes in staffs, etc.

ADDITIONAL TENDERS PENDING

Further information may be had from the issues of *The Canadian Engineer*, to which reference is made.

PLACE OF WORK..	TENDERS CLOSE	ISSUE OF	PAGE
Alberni, B.C., school	Sept. 8.	Aug. 21.	48
Boisdale, N.S., wharf	Sept. 3.	Aug. 21.	50
Bridgeville, N.S., school	Aug. 30.	July 31.	41
Chapleau, Ont., school	Sept. 15.	Aug. 21.	48
Fort William, Ont., bridge	Aug. 30.	Aug. 21.	248
Fort William, Ont., pavements	Aug. 29.	Aug. 21.	248
Halifax, N.S., schools	Aug. 30.	July 31.	41
Hespeler, Ont., water mains	Aug. 30.	Aug. 21.	48
Moose Jaw, Sask., sewer and water mains, water works construction	Aug. 30.	Aug. 21.	48
Ottawa, Ont., pumps, engines, etc.	Aug. 30.	July 31.	44
Peterborough, Ont., public school	Sept. 1.	Aug. 7.	48
Port Hope, Ont., hospital buildings	Aug. 30.	Aug. 21.	50
St. Adolphe, Man., roads and culverts	Sept. 2.	Aug. 21.	46
St. Jean d'Orleans, Que., repairs to wharf	Sept. 3.	Aug. 21.	52
Ste. Martine, Chateauguay, Que., pavement	Aug. 30.	Aug. 14.	42
Toronto, Ont., pavements	Sept. 2.	Aug. 21.	46
Toronto, Ont., postal station "A"	Sept. 5.	Aug. 21.	52
Trenton, Ont., 27 houses	Sept. 1.	Aug. 21.	50
Winnipeg, Man., water recorder	Sept. 1.	July 31.	46
York Township, Ont., sidewalks	Sept. 6.	Aug. 21.	48

BRIDGES, ROADS AND STREETS

Beloeil, Que.—Tenders will be received until 5 p.m., September 8th, by the town council, for reconstruction of macadamized roads. A. M. Cormier, secretary-treasurer.

Boston Creek, Ont.—The provincial government contemplates construction of roads through the Boston Creek mining district to the Skead area.

Brandon, Man.—The city council contemplates construction of the following macadam pavements, including intersections: Eighteenth St., Rosser to Victoria Ave., 42 ft. wide. Estimated cost, $12,755. Princess Ave., First to Sixth St., 42 ft. wide. Estimated cost, $8,254. Princess Ave., Fourteenth to Eighteenth St., 42 ft. wide. Estimated cost, $6,350.30. First St., Rosser to Victoria Ave., two pavements each 19 ft. 6 in. wide. Estimated cost, $12,020.80. Harry Brown, city clerk.

Brandon, Man.—The public parks board contemplate construction of the following works: Boulevard and curb on Princess Ave., both sides, First to Sixth St., length, 2,540 ft. Estimated cost, $2,794, and both sides from Fourteenth to Eighteenth St., length, 1,590 ft. Estimated cost, $1,749. Six foot boulevard and curb on Eighteenth St., Rosser to Victoria Ave., both sides, length, 4,304 ft. Estimated cost, $4,949. Twelve-foot boulevard and curb on First St., Louise to Victoria Ave., both sides, length 1,000 ft. Estimated cost, $2,000. Harry Brown, secretary.

Chatham, Ont.—Tenders will be received until noon, August 30th, by the Chatham township council, for construction of a steel and concrete bridge over the Little Bear Creek drain at the Lindsay Rd. Plans, etc., may be seen at the office of W. G. McGeorge, engineer, Chatham. L. A. Pardo, county roads superintendent, Chatham.

Como East, Que.—Tenders will be received until 6 p.m., September 8th, by the municipal council, for construction of roads. W. Sanderson, secretary-treasurer.

Elmira, Ont.—Construction of the local section of the provincial highway has commenced. This road is being poured in concrete, 16 ft. in width. It is expected that other stretches of concrete highway will be commenced near here in the near future.

Hamilton, Ont.—Plans and estimates are being prepared by the city engineer's department for construction of steps up the mountain on Sherman Ave. E. R. Grey, city engineer.

Haney, B.C.—Tenders will be received until noon, August 30th, by the department of public works, Victoria, B.C., for construction of a bridge on the River road. Plans, etc., offices of district engineer, court house, Vancouver, and at Parliament buildings, Victoria, B.C. A. E. Foreman, engineer.

Islington, Ont.—The Etobicoke township council has awarded contract to the Law Co., Toronto, for construction of 2.75 miles of macadam roadway on Queen St. from Lake Shore Rd. to Kipling Ave. Contract price, $22,200.

Kitchener, Ont.—City council contemplates widening street and constructing a subway on King St., under the G.T. Ry.

Lindsay, Ont.—The county good roads board intend to rebuild the road from the hospital westerly through Mariposa. Estimated cost $10,000 per mile. It was also decided to extend the pavement on Lindsay St. south from the swing bridge to the southern boundary of the Riverside cemetery. B. L. McLean, mayor.

Niagara Falls, Ont.—City council will construct pavement and curb on Benson St., from Victoria to St. Lawrence St.

Niagara Falls, Ont.—City engineer's estimates for pavement consisting of 2 ins. Willite on a 5-in. concrete base for Palmer St., between Benson and Victoria, is $3.35 per sq. yd. Total cost, $43,353.

Ottawa, Ont.—Contracts have been awarded by the department of the interior, Ottawa, for construction of the following roads: Banff-Windermere and the Edith Cavell highways, to J. A. Stephen, 249 Argyle Ave., Ottawa; Castle-Laggan highway to G. R. Long, 51 Sparks St., Ottawa; Mount Revelstoke highway to McPherson & Beam, Regina, Sask. J. B. Harkin, commissioner, Dominion Parks branch, Department of the Interior, Ottawa, Ont.

Portage la Prairie, Man.—Contract has been awarded by the municipal council for construction of reinforced concrete culverts to La Cour & Schioler, 858 McDermot Ave., Winnipeg. D. McCowan, secretary-treasurer.

Quebec, Que.—Of the sixty bridges under construction in the province of Quebec, fifteen are in the district of Quebec, the biggest of which being erected, is the Metabetchouan, 600 ft. long and 100 ft. clear of the river. Ivan Vallee, chief engineer, department of public works, Quebec.

Regina, Sask.—Contracts have been awarded by the department of highways, Regina, for construction as follows: Concrete bridge over Wascana Creek, south-east of Regina, E-9-17-19, west of 2nd meridian, to E. J. St. Onge, Maple Creek, Sask. Concrete abutments over Dog Hide Creek near Tisdale, 1-45-15, west of 2nd meridian, to the Parsons Building Co., Regina. Concrete abutments over Swan River, N.E. ¼-22-34,30, west of 1st meridian, to the Parsons Building Co., Regina. H. S. Carpenter, deputy minister.

Riverside, Man.—Tenders will be received by J. H. Putman, secretary-treasurer, up till noon, on Saturday, September 13th, 1919, for the construction of a 16-ft. span girder bridge on the N. of N.E. ¼-20-5-17. Plans and specifications may be secured from the office of the highway commissioner, Winnipeg.

Sarnia, Ont.—Hon. F. G. Macdiarmid, Ontario minister of public works, has communicated with the local Chamber of Commerce to the effect that the government has under consideration the extension of the provincial highway system in western Ontario. The communication refers to the highway which would connect London and Sarnia, and states that probably a survey of the route will be undertaken shortly.

Scarboro Tp., Ont.—Tenders will be received by W. D. Annis, township clerk, up to noon, Tuesday, September 2nd, 1919, for grading and gravelling Courcelette Road, from Kingston Road to Windsor Ave., and Lakeside Ave., from Kingston Road south. Plans and specifications may be seen at the office of the engineers, James, Loudon & Hertzberg, Ltd., 36 Toronto St., Toronto.

St. Jacobs, Ont.—Construction has commenced on the new 16-ft. concrete, provincial county road north of St. Jacobs. Length of road to be built, three miles. Contractor, Lichty Bros., Wellesley.

Toronto, Ont.—At a meeting of the city council, the following by-laws were passed: extension of Duplex Ave. and opening of Cleveland St., $119,211.73; asphalt pavement on Danforth Ave., widening Kingston Rd. from Balsam to Silver Birch Ave., widening Morton Rd., construction of sewer on Queen St. from Pape to Leslie, $84,559; completion of Strachan Ave. bridge, $16,000, and Cherry St. bridge, $100,000. R. C. Harris, commissioner of works.

Vancouver, B.C.—Tenders will be received by Wm. McQueen, city clerk, up to 2 p.m., Tuesday, September 2nd, 1919, for the construction of a protection pier and fender, at Granville Street bridge. Plans and specifications may be obtained at the city engineer's office, city hall.

Welland, Ont.—City council passed a by-law providing for the construction of a cement sidewalk on the west side Crowland Ave. City Engineer, Charles L. Coulson.

York Township, Ont.—Contracts have been awarded by the county commissioners for construction of the following concrete structures: Abutment for Baldwin bridge to R. H. H. Blackwell, Aurora, Ont., $2,290. Ramsden bridge to W. H. Sheridan, Toronto, Ont., $1,512. Frank Barber, engineer, 40 Toronto St., Toronto.

WATER, SEWAGE AND REFUSE

Brantford, Ont.—The city council has decided to enlarge the pumping station at the waterworks plant. Two new engines and two pumps are being installed at present.

Chatham, Ont.—The engineers are considering a proposition to pump water to Chatham from the Snye. This source of supply will probably be incorporated in the official report.

Edmonton, Alta.—The department of public works, Ottawa, is considering an alternative route for the sewer outlet of the city, to remove same from its present position close to the penitentiary grounds. Commissioner Ormsby.

Edmonton, Alta.—Construction of the clear water basin has commenced. Estimated cost, $30,000. A. W. Haddow, city engineer.

Edmonton, Alta.—Tenders will soon be called for construction of a sewer for the Swift packing plant. Estimated cost, $45,000. A. W. Haddow, city engineer.

Halifax, N.S.—In a report presented to the city board of health, Dr. K. G. Mahabir recommended that the city abandon Chain Lake as a source of supply; purchase certain properties on the water-sheds and draw water from Long Lake and Spruce Hill Lake; extend the existing intakes, which are in the "dead" ends of the lakes into deeper water near the centre.

Hespeler, Ont.—Tenders will be received until 5 p.m., August 30th, by the town council for laying approximately 5,448 lin. ft. of water mains. Town clerk, M. E. Jardine. Engineer, Herbert Johnston, 130 Lancaster St. E., Kitchener, Ont.

London, Ont.—Contract has been awarded by the London township council, for construction of Ox Bow drain, to W. P. Godson & Co., 30 Leopold St., Toronto. Contract price, $10,146.95. Rejected tenders, E. P. Murray, Stratford, $13,300, Peter Winter, Parkhill, $19,500. Mary Grant, clerk.

Moncton, N.B.—The city engineer's department will construct sewer along Victoria Ave., Wesley to Pearl St. J. Edington, city engineer.

Moncton, N.B.—Contract has been awarded by the city council for construction of sewers on Henry and Cornell St., to Lewis Stephens & Co., St. John, N.B. Contract price, $12,786.25.

Parry Sound, Ont.—Contract has been awarded by the town council for construction of a 6-in. water main on Armstrong Ave., to R. Kenny.

Quebec, Que.—Plans and estimates are being prepared by the department of works for construction of sewers in St. Roch's, St. Sauveur and St. Malo on the south side, and along the Limoilou on the north side of the St. Charles River. W. D. Baillairge, city engineer.

Sandwich, Ont.—Town council has awarded contracts for sewers as follows: Randolph and Rankin Ave., to Merlo, Merlo and Ray, $7,000; Felix Ave., to Pettypiece, Ltd., $4,000; Matchet Rd., and Manchester Ave., to West & Sheehan, $15,000.

Sarnia, Ont.—Tenders will be received until 10 a.m., September 1st, by the Sarnia Cemetery Co., for construction of water works system of piping in Lake View Cemetery. M. A. Sanders, secretary, 215½ Front St. N., Sarnia.

Toronto, Ont.—At a recent meeting of the city council, the following by-laws were passed: for relief sewers, $394,000; for extending and improving waterworks, $386,000. R. C. Harris, commissioner of works.

Welland, Ont.—City council passed a by-law for the construction of a sewer on River Road. City engineer, Charles L. Coulson.

Welland, Ont.—A report on the construction of a sewer in the north ward to Parkway Heights was submitted to the city council by City Engineer Coulson. The total cost of the proposed sewer is $39,369. Consideration of the report was laid over until next meeting.

Winnipeg, Man.—The following tenders were received by the department of public works, Winnipeg, for excavating 300,000 cu. yds. material in drainage district No. 2; high tender, Lunt Engineering Co., Winnipeg, 26c. per cu. yd.; low tender, Carter, Halls & Aldinger, Winnipeg, 22.5c. per cu. yd. Estimated cost of work, $81,000. G. A. Grierson, minister.

Woodstock, Ont.—Plans will soon be completed for the treatment and disposal of sewerage for the south side intercepting sewer scheme. By-law to be submitted to the ratepayers, calls for an expenditure of $110,000. City engineer Ure.

York Tp., Ont.—Tenders will be received by the township engineer, Frank Barber, 40 Jarvis St., Toronto, up to 12 o'clock noon, Saturday, September 6th, 1919, for the construc-

No Damage at these Curves!

Entrance to Queen Victoria Park, Niagara Falls, Ont. Roadway surface treated in June 1918 with "Tarvia-B."

When swift and heavy automobiles sweep around the bend of an ordinary macadam road the tires slip sidewise—not enough to skid, to be sure, but enough to rub and rasp the brittle macadam until the stones loosen and the surface ravels.

No road is better than its curves.

The curves are always the first spots in a road that need repair.

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Not so with Tarvia-macadam: Note the excellent condition of the curves in the Tarvia roads pictured here.

Curves have no terrors for Tarvia, because when it is used as a binder it forms a tough matrix for the crushed stone. Not only has Tarvia greater bonding power than natural binder, but it has the further element of *plasticity*, so that it yields instead of crumbling.

Tarvia solves motor-traffic problems.

The use of Tarvia reenforces the road-surface and makes it strong enough to resist motor-driven traffic, which to-day is the biggest problem of the roadmaker.

Likewise with the erosion problem: Water on steep grades washes out plain macadam but does not harm the Tarvia-macadam because it is absolutely waterproof.

And remember, Tarvia roads are also *frost-proof, mudless, and dustless,* and cost less than any other type of good-road construction.

Illustrated booklet describing the various Tarvia treatments free on request.

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Summit Crescent, West Crescent Height, Westmount, a suburb of Montreal. Treated with Tarvia.

Special Service Department

This company has a corps of trained engineers and chemists who have given years of study to modern road problems. The advice of these men may be had for the asking by any one interested. If you will write to the nearest office regarding road problems and conditions in your vicinity, the matter will have prompt attention.

Main Driveway, Queen Victoria Park, Niagara Falls, Ont., north of the Administration Building.

tion of a 6-inch cast-iron water main in Morningside Ave., Lavinia Ave., Ostend and Runnymede Rd., s., 2,784 ft. Plans and specifications may be obtained at the office of the engineer.

York Tp., Ont.—Tenders will be received by the township council for construction of 6-in. cast-iron water mains on Amherst Ave., Jesmond Ave., Ashbury Ave., Roach Ave., Humewood Ave., about 5,214 ft.; Craydon Ave., Ray Ave., Rutherford Ave., Victoria Blvd., Eglinton Ave., Brownhill Ave., Barr Ave., Elora Ave., about 5,066 ft.; Cliff St., Bushey Ave., Jasper Ave., Langden Ave., Orla Ave., Chryessa Ave., Gray Ave., Outlook Ave., Humber Crest Blvd., about 6,139 ft.; Lauder Ave., about 3,200 ft.; Mitchell Ave., about 1,136 ft.; Northland Ave., Lapp St., Spears St., McCormack St., about 3,803 ft.; Northcliffe Blvd. North, Lavinia Ave., Runnymede Rd., Ostend Ave., about 3,043 ft. Engineer, Frank Barber, 40 Jarvis St.

LIGHT, HEAT AND POWER

Kitchener, Ont.—Tenders, addressed to B. G. Michel, city engineer, will be received until noon, Thursday, September 11th, 1919, for the supply and erection of a motor and centrifugal pump, together with appurtenances. Drawings and specifications may be seen at the office of the city engineer.

Moncton, N.B.—Council authorized the city engineer to ascertain cost of erection and installation of an electric light plant at the pumping station for the use of the city, and supply of lights used in the streets and city buildings. J Edington, city engineer.

Nokomis, Sask.—Tenders will be received until 6 p.m., August 30th, by the town council for installation of an electric lighting system. W. A. Armour, secretary-treasurer.

Pickering, Ont.—The Hydro-Electric Power Commission is willing to electrify the old Toronto and Eastern Ry through Pickering, Oshawa and Bowmanville, provided town of Pickering passes by-law guaranteeing bonds to finance the undertaking. Sir Adam Beck, chairman.

RAILWAYS

Brantford, Ont.—City engineer is preparing plans and specifications for double-track approaches to the St. Paul's Ave. subway. Tenders will soon be called. T. H. Jones, city engineer.

Calgary, Alta.—The C.N. Ry. is double-tracking the Drumheller line, constructing concrete bridges, new yards and tunnels. Estimated expenditure for 1919, $1,000,000. A. E. Warren, general manager, western lines.

Kitchener, Ont.—The Grand River Ry. will construct a switch line into the Ames, Holden Tire Co. property along Charles St., as soon as the council grants permission.

Kitchener, Ont.—The board of trade of Kitchener and Wellesley township will request the Grand River Railway to extend their line through Kitchener to Linwood.

Port Arthur, Ont.—An offer has been received by the city council from the Ontario Hydro-Electric Power Commission to take over and operate the street railways of Port Arthur and Fort William. Sir Adam Beck, chairman.

Prince Rupert, B.C.—The C.N. Ry. contemplate large extensions and improvements, new freight sheds, extended yards, new depot, extensions to roundhouse, etc. J. S. Woodward, secretary, board of trade. B. T. Chappell, general superintendent, C.N. Ry.

Toronto, Ont.—The Ontario Railway Board is requesting the Toronto Street Ry. to state when it will construct the Pape Ave. car line. Vice-Chairman Ingram.

Toronto, Ont.—The ratepayers of Ward No. 7 are requesting the city council to extend the civic car lines through the Runnymede-Annette district, taking precedent over extension along Bloor St. through the Runnymede-Jane district.

FACTORIES AND LARGE BUILDINGS

Brockville, Ont.—A smelter may be built here by the Consolidated Iron and Steel Corporation, Ltd., 20 King St. East, Toronto, recently incorporated with a capital of $8,000,000, and backed by Toronto and Detroit interests.

Calgary, Alta.—Permits issued by the city of Calgary for July, 1919, $280,000; July, 1918, $45,000.

Calgary, Alta.—At a meeting, called by the board of trade, the citizens present decided to raise $300,000 to erect a veterans' clubhouse. P. L. Naismith, chairman.

Calgary, Alta.—Contract has been awarded for general work in the construction of additions to the Western Canada College, to Bennett and White Construction Co. Plumbing and heating, J. B. Rogers. Architect, Charles Hay.

Calgary, Alta.—Plans are being prepared by C. W. Fairn, superintendent of buildings, department of education, for a new high school, which will probably be erected on the north hill property, corner of First St. West and Ninth Ave. Estimated cost, $350,000.

Dundas, Ont.—Board of works decided to erect a new steel bridge on Head St. Town clerk, J. J. Fry.

Fort William, Ont.—The site of the Black elevator, recently destroyed by fire, has been purchased with the intention of constructing immediately a large modern elevator. G. R. Duncan.

Galt, Ont.—It is proposed to construct a residence for the Young Women's Christian Association. Estimated cost, $50,000.

Guelph, Ont.—The chamber of commerce contemplates construction of a large covered skating rink. Estimated cost of building, $40,000.

Hamilton, Ont.—Tenders, addressed to Charles G. Booker, mayor, chairman of the board of control, will be received by S. H. Kent, city clerk, up to 10 o'clock a.m. on Tuesday, September 2nd, for the erection of one steel shelter on the Central Market grounds, according to plans and specifications to be seen at the office of Laurence Munro, architect, 36 Main St. East, or at the office of the city engineer, city hall.

Headingly, Man.—The board of the Phœnix school district has decided to erect an addition to school.

Ingersoll, Ont.—By-law will be prepared to provide $120,000 for the erection of a sixteen-roomed Central school.

Islington, Ont.—The Etobicoke township council has granted permission to the Ontario Hydro-Electric Power Commission to construct a new pumping station on College St., at Mimico Creek.

Kitchener, Ont.—The F. W. D. Auto Co. will commence construction of their new factory immediately.

Kitchener, Ont.—The G.W.V.A. of Waterloo and Kingston propose to reorganize the 108th regiment, provided the government will construct and equip a suitable armory. Lieut.-Col. W. M. O. Lochead.

London, Ont.—Permits issued by the city architect show the following construction: Theatre on Dundas St., for J. and J. J. Allen, $100,000, contractor, N. McLeod, Toronto; brick warehouse $25,000, office $15,000, stable $10,000, for the Canadian Oil Co., contractor, R. G. Wilson and Son.

Niagara Falls, Ont.—By-law was passed by council for construction of a technical school as an adjunct of the collegiate institute. Estimated cost, $100,000.

Oshawa, Ont.—Tenders will be received until noon, September 3rd, by the board of education for construction of a four-room addition to Mary St. School. S. B. Coon & Sons, architects, Excelsior Building, Toronto. P. H. Punshon, secretary, Oshawa.

Ottawa, Ont.—The board of the collegiate institute have decided to construct a new building on Percy, Chrysler, First and Carling Ave. Estimated cost, $150,000.

STEEL BARS
FOR CONCRETE REINFORCEMENT
ROUNDS, SQUARES, TWISTED SQUARES,
FLATS, ANGLES.

Preston, Ont.—Contract has been awarded by Otto Homuth, for construction of a new factory to Norman Hipel, Preston.

Regina, Sask.—The Goodyear Tire and Rubber Co. has announced its intention of building a $75,000 block here at once to serve as western headquarters.

Regina, Sask.—Tenders will soon be called for construction of a combined office, warehouse and storage building on Sixth Ave. and Osler St., for Maclean Grocery Co. and Lloyd Fruit Co. Architect, R. J. Bunyard, Moose Jaw.

Regina, Sask.—Tenders will soon be called for construction of a fireproof building, to be equipped with new, modern machinery, to be used as a bakery. Time of completion, December 1st. Estimated cost, $80,000. G. Gillam, president, Manitoba and Western Ontario Bakers' Association.

Salt Springs, N.S.—Tenders will be received by the C.N. Ry. until 12 o'clock, noon, August 30th, for construction of a frame station building and platforms. Plans, etc., offices of chief engineer, Moncton, N.B., resident engineer, Truro, N.S., C.N. Ry. agent, Amherst, N.S. F. F. Brady, general manager, eastern lines.

Sandwich, Ont.—Contracts have been awarded by the school board for construction of a four-roomed school on Wyandotte St., to Wells and Grey. Contract price, $61,000. Plumbing and heating to Windsor Hardware Co. Contract price, $14,000.

Selkirk, Man.—Bulk and separate tenders will be received by E. D. Tuttle, architect, McArthur building, Winnipeg, up to 4 p.m., Wednesday, September 3rd, 1919, for the erection of a Collegiate building for the Selkirk S.D. Blue prints and specifications may be obtained from Mr. Comber, Selkirk, or from the architect.

St. Thomas, Ont.—The F. J. Harding Co. contemplates additions to their factory.

Toronto, Ont.—A new Strand theatre will be erected on the present site, Yonge St., to seat 3,600. Estimated cost, $400,000. Architect, T. Lamb, New York.

Toronto, Ont.—Tenders will be received by the board of control until noon, September 2nd, for public lavatories at Centre Island. T. L. Church, chairman.

Toronto, Ont.—The board of control has instructed the city architect to prepare plans, specifications and estimates of the new stadium to be erected in Rosedale.

Toronto, Ont.—Plans have been completed for an extension to the Western hospital. Estimated cost, $500,000.

Toronto, Ont.—The Imperial Bank of Canada has purchased the north-west corner of King and Yonge Sts. and will erect a new modern building.

Toronto, Ont.—Tenders will be received by the University of Toronto for construction of a building for the Anatomy department. Architects, Darling & Pearson, 2 Leader Lane, Toronto.

Toronto, Ont.—Tenders will be received by the department of education, 155 College St., until 4 p.m., September 10th, for all trades for enlargement of Bedford Park School, Ranleigh Ave. W. C. Wilkinson, secretary-treasurer.

Vancouver, B.C.—A group of local business men, headed by Gordon Jonah, of the Jonah-Piat Co., have formed a company and will erect a woolen mill.

Vancouver, B.C.—T. H. Laslett will construct a new brick factory at 721 Seymour St. Estimated cost, $10,000.

Vancouver, B.C.—The Union Bank has received permit to construct a modern bank building. Estimated cost, $300,000.

Vanderhoof, B.C.—No contract was awarded for construction of Vanderhoof school, for which tenders were called for August 8th. A. E. Foreman, engineer, department of public works, Victoria, B.C.

Whitby, Ont.—The board of Education has decided to proceed with the preparation of plans for the re-building of the Dundas St. School at a cost of about $10,000, and the erection of a new six-room school in the West Ward at an approximate cost of $40,000. Secretary, Dr. C. F. McGillivray.

Willowdale, Ont.—Tenders will be received up to noon, September 10th, 1919, for alterations to York Cottage, Willowdale (North Yonge St.). Plans and specifications may be seen at the office of the architects, James, Loudon & Hertzberg, Ltd., 36 Toronto St., Toronto.

Winnipeg, Man.—A large sheet-iron cattle shed will be constructed by the Public Market Co. at the stockyards. Estimated cost, $40,000.

Winnipeg, Man.—Contract has been awarded by the Marshall Wells Hardware Co., for erection of a warehouse on Rue Des Meurons, St. Boniface, to Carter, Halls & Aldinger. Contract price, $70,000.

Winnipeg, Man.—The Greater Winnipeg Water District Ry. is preparing plans for offices, waiting rooms and a roundhouse. Construction will probably commence before winter.

MISCELLANEOUS

Brockville, Ont.—The Consolidated Iron and Steel Corporation, Ltd., contemplates erection of a pig-iron smelter. Office, 20 King St. E., Toronto.

Cobourg, Ont.—Town council has decided to purchase a motor fire truck equipped with chemical tanks. D. Denton, mayor.

Depot Harbor, Ont.—Tenders will be received until 12 o'clock noon, September 12th, by the department of public works, Ottawa, for renewal of wharf. Plans, etc., at offices of district engineers at Midland, Ont.; Equity building, Toronto, Ont., and post-office at Depot Harbor. R. C. Desrochers, secretary.

Eburne, B.C.—Contract has been awarded by the department of public works, Ottawa, for dredging the north arm of the Fraser River, near Eburne, B.C., to Pacific Dredging Co. Approximate excavation, 950,000 cu. yds. Contract price, 15 cents per cu. yd. R. C. Desrochers, secretary.

Hamilton, Ont.—The works department are preparing plans and estimates for a new concrete coal dock to replace the present wooden structure at West Hamilton. E. R. Grey, city engineer.

Kitchener, Ont.—The city council has passed a motion that equipment for road construction be purchased. Alderman Asmussen.

Lethbridge, Alta.—The ratepayers will vote upon a by-law on September 2nd, providing $35,000 for purchase and installation of water meters.

Ottawa, Ont.—Tenders will be received by John A. Pearson, architect, Centre Block, Parliament Hill, Ottawa, until noon, September 6th, 1919, for the office furniture required for the Parliament Building. Plans, specifications and any other information required may be obtained at the architect's office.

Pandora, Alta.—The Central Alberta Irrigation Association has been formed to bring under irrigation all that section of country lying north of the Red Deer River, from which water can be secured by tapping the Saskatchewan River, using Buffalo Lake as an immense reservoir. Approximate acreage, 2,000,000. President of association, W. Winning, Winnipeg, Man.

Prince Albert, Sask.—P. Burns Co., Ltd., has commenced work on excavations, shipping dock, new transfer spurs and enlargement of the yards. John Burns, general manager, Calgary, Alta.

Purple Springs, Alta.—An irrigation system is contemplated for the surrounding district. Area to be watered, 78,000 acres. J. J. McLellan, Purple Springs, Alta.

Quebec, Que.—The battlefields commission will urge the government to complete the battlefields park scheme, by ac-

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The Northern Electric
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VANCOUVER

quiring all the ground between the citadel and the existing park lands, in addition to the property lying to the west. Estimated additional cost, $500.000.

Sydney, C.B.—The Dominion Iron and Steel Co. have closed down their plant and have placed every available man on the construction of the new plate rolling mill.

Toronto, Ont.—At a recent meeting of the city council the following by-laws were passed: For purchase of additional parks and playgrounds, $150,000; for harbor improvements, $496,000; for purchase of cars for civic car line, $200,000. R. C. Harris, commissioner of works.

Toronto, Ont.—It is said that the Toronto Street Ry. are constructing a number of new palace cars, and that they will be placed in service before winter.

Toronto, Ont.—One mile of cribwork for the new harbor front has been completed and the concrete caps will soon be placed in position. Estimated expenditure, $900,000.

Toronto, Ont.—Tenders will be received until 12 o'clock noon, September 2nd, by the board of control, city hall, for supply and delivery of electric motors. T. L. Church, chairman.

Toronto, Ont.—The board of control contemplates providing for a system of motor buses. Estimated cost, $250,000. T. L. Church, mayor.

Toronto, Ont.—The city council has requested an additional report relative to the safety of the Royal Gorge at Exhibition Park, the Cascades and Scenic Ry. at Scarboro Beach and the Old Mill at the Island.

Toronto, Ont.—The city council may appoint a committee of three to prepare to take charge of the Toronto Ry. at the expiration of its franchise in 1921; to study conditions relative to extensions, type of cars, etc. R. Cameron, controller.

Vancouver, B.C.—C. C. Ballantyne, minister of marine, Ottawa, will decide location in Vancouver harbor for the six new deep water wharves. Estimated cost, $5,000,000.

Vancouver, B.C.—The city council has decided to purchase three two-ton trucks, $12,090; one one-and-a-half-ton truck, $3,060; and one one-ton truck, $2,595, for use of city scavenging department.

Waterloo, Ont.—Contract for steelwork for factory for the F. W. D. Auto Co. has been awarded to the Dominion Bridge Co., Toronto.

Waterloo, Ont.—The board of park management will erect a greenhouse, 15 ft. 6 in. by 58 ft. 4 in. Architect, Lord and Burnham, Toronto.

Winnipeg, Man.—Contract has been awarded by the Greater Winnipeg Water District Ry. for construction of gravel bins, to Carter, Halls & Aldinger. Contract price, $40,000.

Winnipeg, Man.—The committee on fire, water, light and power have decided not to award contracts for permanent repairs to roof of six-million gallon reservoir at McPhillips pumping station. Temporary repairs will be made by the city engineer's department, cost $300. W. P. Brereton, city engineer.

Tenders Called For

TENDERS FOR PUMP AND MOTOR

Sealed tenders, addressed to the undersigned, will be received until noon, Thursday, September 11th, 1919, for the supply and erection of a motor and centrifugal pump, together with appurtenances.

Drawings and specifications may be seen at the office of the City Engineer, Kitchener, Ont.

B. G. MICHEL, C.E.,
City Engineer. 333

TENDERS FOR GRADING

Tenders will be received by the Clerk of the Township of Scarboro up to noon, Tuesday, September 2nd, 1919, for grading and gravelling—

(a) Courcelette Road from Kingston Road to Windsor Avenue.
(b) Lakeside Avenue from Kingston Road south.

Plans and specifications may be seen at the office of the engineers, James, Loudon & Hertzberg, Limited, 36 Toronto Street, Toronto.

J. G. CORNELL, Reeve. W. D. ANNIS, Clerk. 336

TENDERS FOR ALTERATIONS TO BUILDING

FOR YORK COUNTY CHILDREN'S AID SOCIETY

Tenders will be received up to noon, September 10th, 1919, for alterations to York Cottage, Willowdale (North Yonge Street).

Tenders must be marked, sealed and addressed to Mr. R. P. Coulson, 57 Adelaide St. East.

Plans and specifications may be seen at the office of the architects, James, Loudon & Hertzberg, Limited, 36 Toronto Street, Toronto.

HON. G. S. HENDRIE, President. W. D. ANNIS, Secretary. 334

PARLIAMENT BUILDING, OTTAWA

TENDERS WANTED FOR OFFICE FURNITURE

Sealed tenders will be received by the undersigned, until noon, September 6th, 1919, for the "Office Furniture," required for the above building.

All tenders to be based on the manufacture, supply and delivery at the building of the "Office Furniture," as shown and described by the plans and specifications.

The work of this contract shall be proceeded with immediately upon the signing of the same, and continued as may be directed and in such a manner as to ensure completion of the whole work by December 20th, 1919.

Plans, specifications, and any other information required can be obtained at the Architect's Office, Centre Block, Parliament Hill, Ottawa.

Each tender must be accompanied by an accepted cheque on a chartered bank, payable to the order of the Minister of Public Works, for a sum not less than five per cent. (5%) of the amount of the tender, which will be forfeited if the parties tendering decline to enter into a contract when called upon to do so. If the tender is not accepted, the cheque will be returned. If the tender is accepted, an additional cheque for a sum equivalent to five per cent. (5%) of the tender must be deposited before the contract is signed. The total security will be forfeited if the contractor fails to complete the work contracted for.

Payment for material delivered and accepted, will be made monthly.

The lowest or any tender not necessarily accepted.

Envelopes containing tenders to be marked: "Tender for Office Furniture," and addressed to the undersigned.

JOHN A. PEARSON, Architect,
J. O. MARCHAND, Associate.
Centre Block, Parliament Hill, Ottawa. 335

The Canadian Engineer

A Weekly Paper for Civil Engineers and Contractors

Pressure Rise Caused by Gradual Gate Closure

Application of Professor Joukovsky's Theory of Maximum Water-Hammer—Solution of Problem by Arithmetic Integration—Derivation of Formulas—Paper Presented to the American Society of Civil Engineers

By NORMAN R. GIBSON

Hydraulic Engineer, Hydraulic Power Co., Niagara Falls

THE purpose of this paper is to show how the excess pressure in penstocks caused by the gradual closing of turbine gates may be determined from Professor Joukovsky's theory of water-hammer. It will be assumed that the theory of pressure waves, their amplitudes, and speeds of propagation, as formulated by him and proved by his experiments, may be accepted as correct.

At the risk of wearying the reader who is familiar with Joukovskys' work, it is necessary, in connection with what is to follow, to summarize as briefly as possible the principles demonstrated a number of years ago by the distinguished Russian. For a partial translation of his work, the reader is referred to Miss O. Simin's paper entitled "Water Hammer," in the Proceedings of the American Water Works Association, 1904, page 341, which should be examined carefully by every student of this subject.

Joukovsky's experiments, made in 1908 at Moscow, were confined to the instantaneous stopping of the flow of water in long pipes. By his experiments he was able to prove the soundness of his analytical determination of the maximum rise of pressure that would occur when the flow of water in a pipe was suddenly arrested. The casual thinker at first would imagine that—as force is equal to the product of mass by acceleration—an infinite pressure would be produced in a pipe if the water flowing in it were stopped instantaneously. On second thought, he would realize that neither the water column nor the walls of the pipe are rigid, and therefore the pressure caused by the shock of stopping the flow suddenly is relieved by the slight compression of the water and the expansion of the walls of the pipe. It was the effect of these two factors that was determined by Professor Joukovsky. He showed that the shock pressure is transmitted along the column of water in the pipe in waves similar to sound waves; and that the shock pressure is proportional to the destroyed velocity of flow and to the speed of propagation of the pressure waves. This speed depends on the compressibility of water, on the elasticity of the materials of the pipe, and on the ratio of thickness of the walls of the pipe to its diameter. In other words, if the speed of the pressure wave is known, the maximum pressure produced (called water-hammer) by instantaneously stopping water flowing in a pipe at any velocity may be calculated.

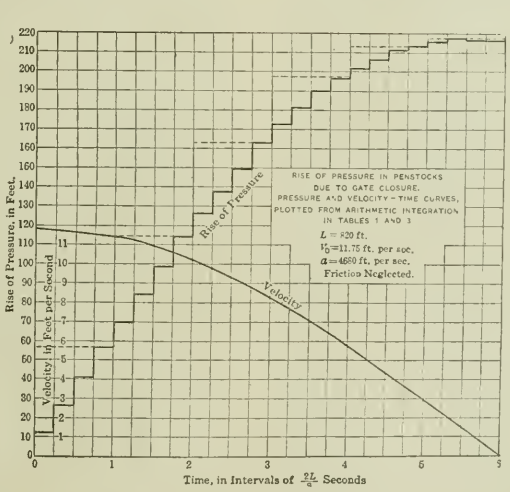

RISE OF PRESSURE IN PENSTOCKS DUE TO GATE CLOSURE.
PRESSURE AND VELOCITY-TIME CURVES, PLOTTED FROM ARITHMETIC INTEGRATION IN TABLES 1 AND 3
L = 820 ft.
V0 = 11.75 ft. per sec.
a = 4680 ft. per sec.
Friction Neglected.
Rise of Pressure
Velocity
Rise of Pressure, in Feet.
Velocity, in Feet per Second
Time, in Intervals of 2L/a Seconds

FIG. 1—PRESSURE AND VELOCITY-TIME CURVES PLOTTED FROM TABLES 1 AND 3

Joukovsky's formula for water-hammer is:—

$$h = aV/g \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where h = excess pressure, in feet;
V = velocity of flow in the pipe, in feet per second;
g = gravitational unit, in feet per second per second;
and a = velocity of the pressure wave, in feet per second, which is determined by the formula:—

$$a = 12 \div [(W/g)(1/k + d/Ec)]^{\frac{1}{2}} \quad \ldots\ldots\ldots\ldots (2)$$

where W = weight of a cubic foot of water, in pounds;
k = voluminal modulus of water, in pounds per square inch;
d = diameter of pipe, in inches;
c = thickness of pipe walls, in inches;
E = modulus of elasticity of material of pipe walls, in pounds per square inch.

Joukovsky showed also that the shock pressure is transmitted along the pipe with constant intensity and "at constant velocity, which seems to be independent of the intensity of the shock."

"The speed of propagation of the pressure wave remains the same, whether the shock is caused by arresting the flow of a column of water moving in a pipe, or by suddenly changing the pressure in the column of water (flowing or standing) in any part and by any other means."

"If the water column continues flowing, such flow exerts no noticeable influence upon the shock pressure. In a pipe from which water is flowing, the pressure wave is reflected from the open end of the pipe, in the same way as from a reservoir with constant pressure."

"The phenomenon of periodical vibration of the shock pressure is completely explained by the reflection of the pressure wave from the ends of the pipe, i.e., from the gate and from the origin [of the pipe]."

(These quotations are from Miss Simin's "Water Hammer.")

Pressure waves, after travelling up the penstock to the

origin or point of relief and back to the gate, are reflected and transmitted again over the same course, as waves of rarefaction or sub-normal pressure. In this manner pressure waves, alternately super-normal and sub-normal, travel up and down the penstock until damped out by friction. During the time taken by the wave to traverse its course from gate to origin the pressure at the gate remains at its full value, either super-normal or sub-normal, as the case may be.

Briefly stated, then, the premises are: that when water flowing in a pipe is suddenly arrested, certain pressure waves, the characteristics of which are known, are produced and

TABLE 1—BY ARITHMETIC INTEGRATION

Data: L = 820 ft. V_o = 11.75 ft. per sec. H_o = 165 ft. T = 2.1 sec. a = 4,680 ft. per sec. Friction neglected.

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Interval.	Time, t.	Gate, B.	Head, H.	Velocity, V.	145 ΔV, Δh.	$\Sigma(\Delta h)$, h_t.
0	0.0000	0.81476	165.00	11.75		
		0.08811		0.085	12.32	
¼	0.0875	0.87665	177.32	11.665		12.32
		0.08811		0.095	13.78	
½	0.1750	0.93854	191.10	11.570		26.10
		0.08811		0.10	14.50	
¾	0.2625	0.80043	205.60	11.47		40.60
		0.08811		0.112	16.20	
1	0.3500	0.76232	221.80	11.358		56.80
		0.08811		0.258	37.40	
1¼	0.4375	0.72421	234.56	11.10		69.56
		0.08811		0.29	42.10	
1½	0.5250	0.68610	249.10	10.81		84 10
		0.08811		0.30	43.50	
1¾	0.6125	0.64799	263.60	10.51		98 60
		0.08811		0.33	47.80	
2	0.7000	0.60988	279.00	10.18		114 00
		0.08811		0.43	62.30	
2¼	0 7875	0.57177	291.14	9.75		126 14
		0.08811		0.47	68.20	
2½	0 8750	0.53366	302.70	9.28		137 70
		0.08811		0.48	69.60	
2¾	0 9625	0.49555	314 80	8.80		149.30
		0.08811		0.53	76 80	
3	1.0500	0.45744	327.90	8.27		162.90
		0.08811		0.58	84.00	
3¼	1 1375	0.41933	337.46	7.69		172.46
		0.08811		0.61	88.40	
3½	1.2250	0.38111	346.10	7.08		181.10
		0.08811		0.62	90.00	
3¾	1 3125	0.34300	354.80	6.46		189.90
		0.08811		0.67	97.10	
4	1.4000	0.30489	361.60	5.79		196.60
		0.08811		0.68	98.60	
4¼	1 4875	0.26678	366.60	5.11		201.64
		0.08811		0.70	101.50	
4½	1.5750	0.22867	371.10	4.41		206.10
		0.08811		0.715	103.80	
4¾	1.6625	0.19056	376.10	3.695		211.10
		0.08811		0.739	106.00	
5	1.7500	0.15245	378.30	2.965		213.30
		0.08811		0.739	106.00	
5¼	1.8375	0.11434	380.68	2.235		215.66
		0.08811		0.745	108.00	
5½	1.9250	0.07623	382.70	1.490		217.70
		0.08811		0.745	108.00	
5¾	2 0125	0.03812	384.90	0.745		219.90
				0.745	108.00	
6	2.1000	0.0	386.70	0.0		221.70

propagated along the pipe at constant speed and constant magnitude, and that the speed and magnitude of these waves may be calculated for any given conditions.

Fundamental Equations

It is the writer's intention to apply herein this theory of pressure waves to the phenomena which occur when the gates of a turbine at the end of a penstock are gradually closed. The damping effect of friction on the pressure waves will be neglected during the time of closure. The variable velocity of the pressure wave due to the difference in density of the water at the top and bottom of the penstock will also be neglected. For the sake of simplicity, it will be assumed that the gate opening is closed uniformly from full open to shut by a governor which moves the gates at uniform velocity from the beginning of its stroke to the end, and that the area of gate opening is directly proportional to the amount of gate movement. It may be stated here, parenthetically, that the resulting formulas may be modified, easily, to suit any method of gate closure, whether the speed of closing and the relation of governor movement to area of gate opening is uniform or variable.

When the gates of a turbine are closed gradually the velocity of the water in the penstock is reduced to zero and the pressure in the penstock rises. It is frequently assumed that the reduction in velocity takes place uniformly, but the rise of pressure, which commences immediately after the gates begin to move, increases the velocity of discharge through the gate opening, and, during the early part of the gate movement, tends to diminish the rate at which the flow of the water is retarded. This variable rate of retardation, during the time the gates are being closed, has an important bearing on the resulting rise of pressure, and it is necessary to take it into consideration by determining the relation between the velocity of flow and the pressure in the penstock. This relation may be expressed by the equation:—

$$V_o = B_o(H_o)^{\frac{1}{2}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

where V_o = initial velocity, in feet per second, of the water in the penstock before shut down;

H_o = normal net head, in feet;

and B_o = a number representing the gate opening. The value of B_o is best determined from the known value of V_o and H_o, but, in fact, B_o is the ratio of the area of the penstock multiplied by $(2g)^{\frac{1}{2}}$ times the coefficient of discharge of the gate opening.

At any time during the closing of the gates the relation between V, B, and H would be expressed by the general formula, $V = B(H)^{\frac{1}{2}}$. If the gates are closed in the time, T, and t is the time from the beginning of the stroke to any time before the end of the stroke, the value of B_t (that is, B at the end of the time, t) for uniform closing, would be $(1-t/T)B_o$. During the time, t, the pressure in the penstock has risen an amount, h_t, so that the net head, H_t (that is, H at the end of the time, t) would be equal to H_o+h_t. There-

TABLE 2—BY ARITHMETIC INTEGRATION

Data: L = 6,337 ft. V_o 15,055 ft. per sec. H_o = 1,260 ft. T = 69.5 sec. a = 3,647 ft. per sec. Friction head h_t = 81 ft.

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Interval.	Gate,* B.	Head, H.	Velocity, V	113 ΔV, Δh.	$\Sigma \Delta h$.	3.674 V^2, h_f.	Δh_f.	$\Sigma(\Delta h + \Delta h_f)$ h_t.
0	0.4211	1260.0	15.053		.. .	81.0	....	.. .
			0.155	17.5				
1	0.4168	1279.2	14 90		17.5	79.8	1 7	19.2
			0.29	32.8				
2	0.4084	1279.8	14.61		15.3	76.5	4.8	19 8
			0.28	31.7				
3	0.3995	1284.0	14.33		16:4	73.4	7 8	24.0
			0.33	37.8				
4	0.3895	1291.8	14.00		29.9	70.1	10.9	31 8
			0.37	41.8				
5	0.3784	1295.5	13.63		20.9	66.4	14 0	35.6
			0 42	47 5				
6	0.3657	1305.3	13.21		26.6	62.3	18.7	45 8
			0.49	55.4				
7	0.3513	1311.8	12.72		28.6	58.0	23.0	51.8
			0.53	59.8				
8	0.3354	1319.0	12 19		31.0	53.0	28 0	59.0
			0.60	67.8				
9	0.3180	1329.8	11.59		36.8	48.0	33.0	69.8
			0.65	73.6				
10	0.2991	1334 9	10 94		36.7	42.8	38 2	74.9
			0.72	81.3				
11	0.2781	1348.2	10.22		41.6	37.4	43 6	88.2
			0.84	94.8				
12	0.2544	1359.7	9.38		50.2	31.5	49.5	99.7
			0 92	104.0				
13	0.2285	1369.2	8 46		58.8	25.6	55.4	109 2
			0.97	109.5				
14	0.2009	1376.6	7.49		55.7	20.1	60.9	116 6
			1.07	121.0				
15	0.1719	1391.6	6.42		65.3	14.7	66.3	131.6
			1.15	130.0				
16	0.1411	1395.8	5.27		64.7	9.9	71.1	135.8
			1.21	136.8				
17	0.1083	1407.2	4.06		72.1	6.9	75.1	147.2
			1.28	150.1				
18	0.0725	1416.3	2 78		78.0	2.7	78.3	156.3
			1.365	164.2				
19	0.0363	1416.5	1.365		76.2	0.7	80.3	156.6
			1.365	154 2				
20	0.	1419.0	0.		78.0	0.	81.0	159.0

* Non-uniform gate motion.

fore, the expression for the value of V_t (that is V at the end of the time, t) is:

$$V_t = (1-t/T)B_o(H_o+h_t)^{\frac{1}{2}} \quad \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Calculation by Arithmetic Integration

Before proceeding with the analytical determination of h_t, it will perhaps make the work clearer to show first, by a numerical example, how h_t may be obtained by the trial-and-error method of arithmetic integration. Assume that the gate, instead of being moved in a continuous uniform manner, is closed by a series of small instantaneous move-

ments with a slight pause between each movement. Each little movement of the gate would destroy instantaneously a small part, ΔV, of the velocity, V_o, and, since this part of the velocity is destroyed instantaneously, the rise of pressure, according to Joukovsky, would be $h = a\Delta V/g$. When the first instantaneous movement has taken place, let a pause of time, t, elapse before the next movement. Then $\Delta V = V_o - V_t$, and $h_t = a(V_o - V_t)/g$.

By these equations and Equation (4) a numerical example may now be solved, and at the same time there will be explained other interesting phenomena caused by the closing of the gates and the pressure waves produced thereby. The analytical work may then be more readily understood.

Let $L = 820$ ft.;
$V_o = 11.75$ ft. per sec.;
$H_o = 165$ ft.;
$T = 2.1$ sec. (For convenience, T has been chosen an even multiple of $2L/a$).
$a = 4{,}680$ ft. per sec. (This value of a is chosen simply because this example was worked out by the writer for a pipe in a tunnel and concreted in. The expansion of the pipe walls, therefore, was neglected. For any condition, a may be obtained by Equation (2).

Since $V_o = B_o(H_o)^{.5}$, then $B_o = 0.91476$.

Assume that the gates are closed in 24 successive instantaneous movements. The time elapsing between each movement would then be 0.0875 sec. After the first of these movements had taken place the gates would have been closed one-twenty-fourth of their opening, and the number representing the gate opening would have been reduced by one-twenty-fourth of its value, that is, $0.91476/24 = 0.038115$. At each of the successive movements the value of B is reduced by the same amount, as the gate motion is assumed to be uniform. It will be necessary, however, to use more than the first three significant figures, and the work may be done on the slide-rule. In this example the recovery of the friction head in the penstock will be neglected.

From the foregoing may now be written the first three columns of Table 1, and the first line of Columns 4 and 5. The table may then be completed as follows: Assume a trial reduction in velocity, caused by the initial instantaneous movement of the gate, and set the figure down in Column 5 under the value of V_o and subtract it from V_o, placing the difference immediately underneath. This trial figure is ΔV, and is assumed to be destroyed instantaneously by the first movement of the gate. A pressure wave, Δh, of magnitude, $a\Delta v/g = 4{,}680(\Delta V)\ 32.2 = 145\Delta V$, is therefore started up the pipe. The product of 145 ΔV is set down in Column 6 opposite ΔV. In Column 7 is recorded the algebraic sum of the value of Δh. Having obtained the figure in Column 7, it is added to the net head, $H_o = 165$, and the sum is set down in the next line lower in Column 4. The result must now be checked, to see that $B(H)^{.5} = V$, where B is 0.8766 and H and V have the values recorded in their respective columns opposite B. If the relation is not satisfied, a new trial value of ΔV must be chosen, and the operations repeated until a check is obtained. After trial, the initial value of ΔV was found to be 0.085. Proceeding in this way, the rise of pressure at the end of 0.35 sec. is found to be 56.80 ft. This rise has taken place in four successive jumps.

At this point it becomes necessary to trace the course of the pressure wave started up the penstock by the initial movement of the gate. This wave has a velocity of 4,680 ft. per sec., and travels at that rate toward the forebay or origin of the penstock; after arriving at the origin it is reflected and returns to the gate at the same velocity. The distance from gate to forebay and return is 1,640 ft., so that the pressure wave takes 0.35 sec. to cover this distance. On its arrival at the gate it is reflected immediately as a wave of sub-normal pressure, and commences its journey again from gate to forebay and back. At the instant the wave becomes sub-normal, however, the gate is given one of its instantaneous closing movements, causing a further reduction in the velocity of the water flowing in the penstock and the consequent rise of pressure incident thereto. Thus, at this instant, two factors have to be taken into consideration: the rise of pressure caused by the fifth little instantaneous movement of the gate and the fall in pressure caused by the change from super-normal to sub-normal of the pressure wave produced by the first or initial movement of the gate which occurred 0.35 sec. before.

By trial-and-error the velocity that has been destroyed by the fifth movement of the gate is found to be 0.258 ft. per sec., and the result is checked as follows. Multiplying 0.258 by 145, the magnitude of the resulting pressure wave is 37.4 ft., and this added to 56.80 would make the total excess pressure existing equal to 94.20 ft., were it not for the fact that the initial wave has returned to the gate and become sub-normal. The amount of the initial wave, as shown by the second line of Table 1, is 12.32, and since it not only falls to

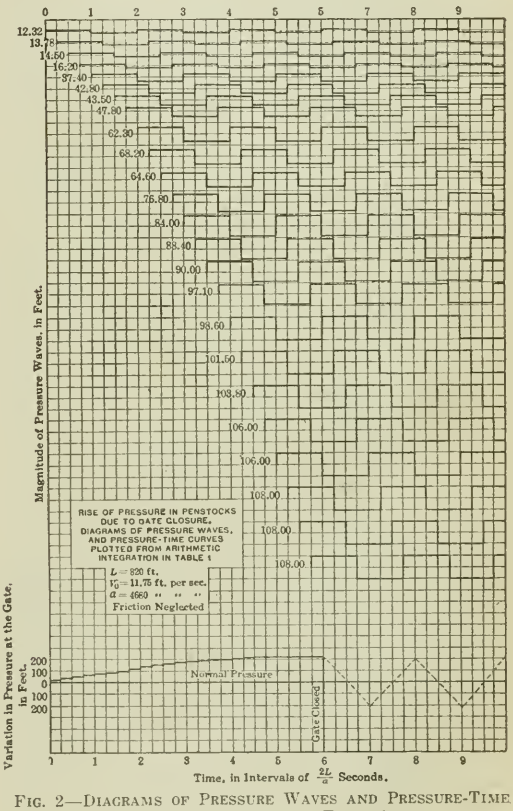


FIG. 2—DIAGRAMS OF PRESSURE WAVES AND PRESSURE-TIME CURVES PLOTTED FROM TABLE 1

zero but passes below zero to a sub-normal pressure of equal amount, making the net excess pressure existing at that instant 69.56 ft. Adding this to the initial net head $H_o = 165$, the value of V is checked as before by the formula, $V = B(H)^{.5}$.

Proceeding then as before, and remembering that the pressure rise caused by the sixth movement of the gate is reduced by the second movement of the gate, and the pressure rise of the seventh movement is reduced by the wave produced by the third movement, and so on, there may be calculated the successive increments of pressure.

For convenience, the time required by the pressure waves to travel from the gate to the origin of the pipe and return to the gate again will be called one interval. The inter-

fering waves referred to in the foregoing paragraph are then always one interval apart.

After the eighth movement of the gate has taken place, it is found that the next excess pressure has reached 114.00 ft. At the instant the ninth movement takes place it must be noted that the pressure wave produced by the first movement of the gate, which has traveled, during the first interval, from the gate to the origin and back as a wave of super-normal pressure, and during the second interval over the same course as a wave of sub-normal pressure, has now returned to the gate and, again becoming super-normal, is again reflected and commences its journey from gate to origin and back. Thus, at the ninth movement of the gate, there must be taken into consideration the pressure wave caused by the instantaneous destruction of the velocity at that instant, the sub-normal wave due to the fifth movement, and the super-normal wave due to the first movement. After adding to the excess pressure existing at the end of the eighth movement, the rise of pressure caused by the ninth movement, there must be subtracted twice the pressure caused by the fifth movement, and there must be added twice the pressure caused by the first movement, or, in other words, there is subtracted twice the difference between the fifth and first waves.

By thus keeping in mind the position of the wave propagated by each movement of the gate, Table 1 may be

TABLE 3—BY ARITHMETIC INTEGRATION
For Data, see Table 1.

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Interval.	Time, T.	Gate, B.	Head, H.	Velocity, V	$145\,\Delta V$, Δh.	$\Sigma\,(\Delta h)$, h_f.
0	0.0	0.91476	165.00	11.75		.....
				0.392	56.8	
1	0.35	0.762	221.8	11.358		56.8
				1.178	171.0	
2	0.70	0.608	279.2	10.18		114.2
				1.91	277.0	
3	1.05	0.457	327.8	8.27		162.8
				2.48	360.0	
4	1.40	0.304	362.20	5.79		197.2
				2.825	410.0	
5	1.75	0.1525	377.8	2.965		212.8
				2.965	430.0	
6	2.10	0.0	382.2	0.00		217.2

completed, and the resulting maximum rise of pressure is found to be 217.70 ft.

Fig. 2 is a series of graphical diagrams showing the magnitude of the pressure waves caused by the successive instantaneous movements of the gate. A separate diagram is drawn for each movement, pressure being represented by the ordinates and time by the abscissas. The change from super-normal to sub-normal and *vice versa* is shown at the end of each interval of time. Fig. 1 is the excess pressure-time curve plotted from the figures in Column 7 of Table 1, or, what amounts to the same thing, from the algebraic sum of the pressure waves shown in Fig. 2.

Table 2 shows the method of determining the results when the recovery of friction in the penstock is included, an example being selected where the friction head is an appreciable quantity. The operations are almost identical with those just described, up to Columns 6 and 7. To avoid reference to the foregoing, however, the formation of Table 2 will be described from the beginning. In the first line, opposite $B = 0.4241$, set down Columns 3, 4, and 7, the known values of H_0, V_0, and h_f (friction head). Next, assume a trial reduction in velocity, caused by the initial instantaneous movement of the gate, and set the figures down in Column 4 under the value of V_0, and subtract it from V_0, placing the difference immediately underneath. This trial figure is $\Delta V'$, and is assumed to be destroyed instantaneously by the first movement of the gate. A pressure wave, Δh, of magnitude $= (\Delta V')a/g = (\Delta V')3647/32.2 = 113\Delta V'$, therefore, is started up the pipe. The product of 113 $\Delta V'$ is set down in Column 5 opposite ΔV. In Column 6 is recorded the algebraic sum of the values of Δh. In Column 7 the total friction head, due to the velocity shown in Column 4, is set down, and, in Column 8, the friction head recovered at each operation is shown. For convenience, h_f may be made equal to FV^2, in which F is a coefficient obtained from the known values at the beginning. In the example, $F = 0.3574$. Column 9 shows the sum of the opposite items in Columns 6 and 8. Having obtained the figure in Column 9, it is added to the net head, $H_0 =$ 1,260, and the sum is set down in the next lower line in Column 3. The result must now be checked, to see that $B(H)^{\frac{1}{2}} = V$, where B is now 0.4168, and H and V are the values opposite. If the relation is not satisfied, a new trial value of ΔV must be chosen, and the operations repeated until a check is obtained. After trial, the initial value of $\Delta V'$ was found to be 0.155. The operations for obtaining the figures on the third line are not quite the same as those just described because, after assuming the next trial value of $\Delta V'$, and multiplying it by 113, it must be remembered that the resulting pressure at the gate is reduced by the return of the first wave, which has traveled up to the forebay and back, and now changes to sub-normal and repeats the journey. The time at which the gate is given its second movement has been selected purposely to coincide with the return of the first wave. The item opposite Interval 2, in Column 6, therefore, is the difference between the first two figures in Column 5. The other operations are similar to those already described, and the resulting figures in Columns 3 and 4 are checked similarly with the value of $B = 0.4084$. The succeeding lines are filled in by the same process, always keeping in mind the return of the preceding waves, and whether they change to sub-normal or super-normal. A little study will disclose the fact that the figure in the second line of Column 6 may be obtained by subtracting the figure in the first line of Column 6 from the figure in the second line of Column 5. Similarly, the figure in the third line of Column 6 may be obtained by subtracting the figure in the second line of Column 6 from the figure in the third line of Column 5, and so on.

At this point it is interesting to repeat the trial-and-error work for the foregoing example worked out in Table 1, but using only 6 instantaneous movements of the gate instead of 24. The results are shown in Table 3, and the pressure-time curve in dotted lines in Fig. 1. From these it will be noted that the total rise of pressure is the same as that obtained by the calculations for 24 movements, and, moreover, the resulting pressure at the end of each interval is the same in both cases. Although six movements of the gate, or one movement to each interval of time, are sufficient to determine the pressure rise at the end of each interval, it requires the larger number of movements to obtain intermediate points on the pressure-time curve. If a still greater number of movements is taken, the increments in pressure rise become smaller, and, in the limit, the stepped diagrams similar to Fig. 1 would become a series of smooth curves from the beginning to the end of each interval. The diagram, however, would not necessarily form a smooth curve from the beginning to the end of the closing time, because cusps or changes of curvature at the end of each interval result from the action of the pressure waves in changing at that instant from super-normal to sub-normal or *vice versa*. When the duration of closure is short, the change of curvature in the diagram at the end of each interval is frequently very apparent; but, when the duration of closure is long, the changes of curvature in many cases cannot be detected by the eye. These changes of curvature at the end of the intervals make it difficult to formulate the integration which can so easily be performed by the trial-and-error work already explained.

It is possible, however, to obtain a series of equations, one for each interval of the closing time, that constitute a direct mathematical solution of the problem, without recourse to trial-and-error methods. The foregoing example has been explained in order that the analytical work may be more easily understood, and in order that the method of tracing the course of the pressure waves and keeping track of their periodic changes may be kept clearly in mind. More particularly, it should be borne in mind that though a formula may be written for the pressure rise in the first interval, using only the known quantities existing before the shut-down, the formulas for the pressure rise in any succeeding interval will involve, as one of the known quantities, the value of the pressure rise at the end of the preceding interval. It thus becomes necessary, when calculating the

pressure rise at any time during, or at the end of, the closing of the gate, to obtain first the amount of the pressure rise at the end of each preceding interval. Moreover, if it is desired to determine the pressure rise at any time between the beginning and end of any interval—that is, at any fractional part of an interval—not only is it necessary to determine the pressure rise at the end of each preceding interval, but also the pressure rise at the same fractional part of each preceding interval. This also applies in determining the excess pressure-time curve when the duration of closure is not exactly a whole number of intervals.

NOMENCLATURE

L = length of penstock, in feet;
a = velocity of pressure wave, in feet per second;
g = acceleration due to gravity, in feet per second per second;
$2L/a$ = one interval of time;
T = governor time, in seconds, *i.e.*, total duration of gate closure;
$T_1, T_2, T_3, \ldots T_n$ = Time at the end of the 1st, 2nd, 3rd, ... nth interval;
$t_1, t_2, t_3, \ldots t_n$ = any time during the 1st, 2nd, 3rd, ... nth interval;
n = any number of intervals; the final interval in the time, T, need not be complete;
H_0 = normal net head, in feet;
$h_1, h_2, h_3, \ldots h_n$ = excess pressure above normal, in feet, existing at the end of the 1st, 2nd, 3rd, ... nth interval, *i.e.*, at the times, $T_1, T_2, T_3, \ldots T_n$;
$h_{t_1}, h_{t_2}, h_{t_3}, \ldots h_{t_n}$ = excess pressure above normal, in feet, at any time during the 1st, 2nd, 3rd, ...nth interval, *i.e.*, at the times, $t_1, t_2, t_3, \ldots t_n$;
V_0 = initial velocity, in feet per second, of the water in the penstock before shutdown.
$V_1, V_2, V_3, \ldots V_n$ = velocity, in feet per second, of the water in the penstock at the end of the 1st, 2nd, 3rd, ... nth interval;
$V_{t_1}, V_{t_2}, V_{t_3}, \ldots V_{t_n}$ = velocity, in feet per second, of the water in the penstock at any time, t_1, t_2, t_3, ... t_n, during the 1st, 2nd, 3rd, ... nth interval;
$B_0 = V_0/(H_0)^{1/2}$ = a number representing the gate opening;
$S_{t_1} = (a/g)^2(1-t_1/T)^2B_0^2$
$S_{t_2} = (a/g)^2(1-t_2/T)^2B_0^2$
$S_{t_n} = (a/g)^2(1-t_n/T)^2B_0^2$
$C_{t_1} = (2a/g)(V_0-V_{t_1})$
$C_{t_2} = (2a/g)(V_1-V_{t_2})-C_{t_1}$
$C_{t_n} = (2a/g)(V_{n-1}-V_{t_n})-C_{t_{(n-1)}}$
F = a friction factor such that FV^2 = total loss, in feet of head, for velocity, V
$R_0 = (a/g)V_0$
$R_{t_1} = h_1+(a/g)V_1-C_{t_1}$
$R_{t_2} = h_2+(a/g)V_2-C_{t_2}$
$R_{t_{(n-1)}} = h_{n-1}+(a/g)V_{n-1}-C_{t_{(n-1)}}$
$Z_1 = (a/g)^2S_{t_1}/[(a/g)^2+S_{t_1}F]$
$Z_2 = (a/g)^2S_{t_2}/[(a/g)^2+S_{t_2}F]$
$Z_n = (a/g)^2S_{t_n}/[(a/g)^2+S_{t_n}F]$.

Time is always to be measured from the beginning of the gate movement. Thus, the time, t_2, is the time from the beginning of the stroke to some time between the first and third intervals. The successive values of t_1, t_2, etc., must always be one interval apart.

First: Derivation of Formulas with Friction Neglected. —Joukovsky's formula for water-hammer, as already stated in Equation (1), is:

$$h = aV/g.$$

During slow closing of the gate, $dh = (a/g)dV$.

At the beginning of the closing time, as already stated in Equation (3),

$$V_0 = B_0(H_0)^{1/2}$$

and, in general,

$$V = B(H_0+h)^{1/2}.$$

For the first interval,

$$\int_0^{h_{t_1}} dh = (a/g)\int_{V_{t_1}}^{V_0} dV$$

where h_{t_1} = pressure rise at any time, t_1, during the first interval, and V_{t_1} = velocity at the time, t_1, during the first interval.

Integrating, then:—

$$h_{t_1} = (a/g)(V_0-V_{t_1}) \quad \ldots\ldots\ldots\ldots\ldots\ldots (5)$$

Since V_{t_1} must be proportional to the gate opening multiplied by the square root of the head, then, for uniform gate motion:—

$$V_{t_1} = (1-t_1/T)B_0(H_0+h_{t_1})^{1/2} \quad \ldots\ldots\ldots\ldots (6)$$

Substituting this value of V_{t_1} in the equation for h_{t_1}, the latter becomes:—

$$h_{t_1} = (a/g)V_0-(a/g)(1-t_1/T)B_0(H_0+h_{t_1})^{1/2}$$

For simplicity, substitute the symbol, R_0, in place of $(a/g)V_0$, and the symbol, $(S_{t_1})^{1/2}$, for $(a/g)(1-t_1/T)B_0$. Thus:—

$$h_{t_1} = R_0-[S_{t_1}(H_0+h_{t_1})]^{1/2}$$

Squaring:—

$$(h_{t_1}-R_0)^2 = S_{t_1}(H_0+h_{t_1})$$

Expanding:—

$$h_{t_1}^2-2h_{t_1}R_0+R_0^2 = S_{t_1}H_0+S_{t_1}h_{t_1}$$

Collecting:—

$$h_{t_1}^2-h_{t_1}(S_{t_1}+2R_0)+R_0^2-S_{t_1}H_0 = 0$$

Solving:—

$$h_{t_1} = \tfrac{1}{2}\{(S_{t_1}+2R_0)\pm[(S_{t_1}+2R_0)^2-4R_0^2+4S_{t_1}H_0]^{1/2}\}$$

Simplifying:

$$h_{t_1} = \tfrac{1}{2}\{(S_{t_1}+2R_0)\pm[S_{t_1}(S_{t_1}+4R_0+4H_0)]^{1/2}\} \quad \ldots\ldots (7)$$

For the second interval, an examination of Table 1 will show that—

$$\int_0^{h_{t_2}} dh = (a/g)\int_{V_{t_2}}^{V_1} dV+h_1-2(a/g)\int_{V_{t_1}}^{V_0} dV$$

Where h_{t_2} = pressure rise at any time, t_2, during the second interval;
V_{t_2} = velocity at the time, t_2;
V_1 = velocity at the end of the first interval;
h_1 = pressure rise at the end of the first interval;
V_{t_1} = velocity at the time, t_1, which must be exactly one interval before the time, t_2.

Integrating, then:—

$$h_{t_2} = (a/g)(V_1-V_{t_2})+h_1-2(a/g)(V_0-V_{t_1}) \quad \ldots (8)$$

Substituting C_{t_1} for $2(a/g)(V_0-V_{t_1})$,

$$h_{t_2} = (a/g)(V_1-V_{t_2})+h_1-C_{t_1}$$

Again, since V_{t_2} must be proportional to the gate opening multiplied by the square root of the head, then, for uniform gate motion:—

$$V_{t_2} = (1-t_2/T)B_0(H_0+h_{t_2})^{1/2} \quad \ldots\ldots\ldots\ldots (9)$$

Substituting this value of V_{t_2} in the equation for h_{t_2}, the latter becomes

$$h_{t_2} = (a/g)V_1-(a/g)(1-t_2/T)B_0(H_0+h_{t_2})^{1/2}+h_1-C_{t_1}.$$

Substituting the symbol, R_{t_1}, in place of $(a/g)V_1+h_1-C_{t_1}$, and the symbol, $(S_{t_2})^{1/2}$, for $(a/g)(1-t_2/T)B_0$,

$$h_{t_2} = R_{t_1}-[S_{t_2}(H_0+h_{t_2})]^{1/2}$$

Squaring:—

$$(h_{t_2}-R_{t_1})^2 = S_{t_2}(H_0+h_{t_2})$$

Expanding:—

$$h_{t_2}^2-2h_{t_2}R_{t_1}+R_{t_1}^2 = S_{t_2}H_0+S_{t_2}h_{t_2}.$$

Collecting:—

$$h_{t_2}^2-h_{t_2}(S_{t_2}+2R_t)+R_{t_1}^2-S_{t_2}H_0 = 0.$$

Solving:—

$$h_{t_2} = \tfrac{1}{2}\{(S_{t_2}+2R_{t_1})\pm[(S_{t_2}+2R_{t_1})^2-4R_{t_1}^2+4S_{t_2}H_0]^{1/2}\}$$

Simplifying:—

$$h_{t_2} = \tfrac{1}{2}\{(S_{t_2}+2R_{t_1})\pm[S_{t_2}(S_{t_2}+4R_{t_1}+4H_0)]^{1/2}\} \quad \ldots (10)$$

In a similar manner, the value of h, at any time in any interval, may be found.

(Concluded in the next issue)

Hon. A. L. Sifton, who has been Minister of Customs and Inland Revenue in the Dominion Cabinet, is relinquishing that portfolio to accept the one recently surrendered by Hon. F. B. Carvell; in other words, Mr. Sifton will be Minister of Public Works. He is a lawyer, and was formerly premier of Alberta.

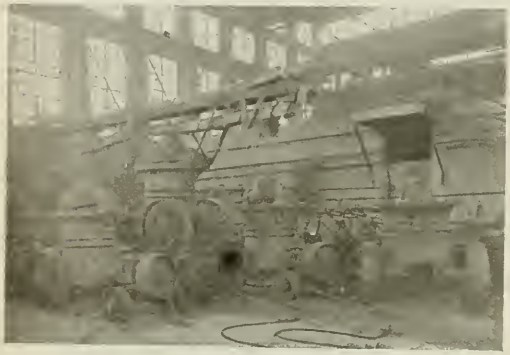
LARGE PORTABLE ROAD CRUSHERS

By R. R. Shafter
Engineer, Traylor Engineering & Mfg. Co., Allentown, Pa.

EIGHT portable gyratory crushers, believed to be the largest of their kind ever constructed, were built last year in the shops of the Traylor Engineering & Manufacturing Co., of Allentown, Pa., for the use of the American Expeditionary Force in road construction work in France.

The accompanying illustration shows some of these crushers in process of assembly in the Traylor shops. Each of the crushers weighs about 8 tons. They are made of cast steel practically throughout, in order to reduce the weight and increase the strength. They are capable of handling stone of "one man size" or up to 11 ins., and each crusher has a capacity of 25 tons of 2-in. stone per hour, with a power consumption of only 18 k.w.

The machines are of the "Bulldog" design, wherein the crusher-shaft is decidedly shorter than in the old type of



Large Portable Crushers Partly Assembled

gyratory crusher, thus decreasing the likelihood of bending or breaking the shafts.

Each crusher is mounted on a heavy set of road wheels, with a pair of front wheels under the support or outboard bearing of the countershaft of the machine. On the end of the countershaft is supplied a pulley for driving a folding elevator, which equipment was furnished with each crusher.

This type of machine proved to be a very durable, compact and economical crusher for road and general work, and on account of the extensive road building programs now under way, the Traylor Co. is preparing to add a line of these large portable crushers to the other machines which the company carries in stock.

PROPOSES DRAINAGE CANAL FOR NIAGARA

THE problem of freeing the Niagara river from sewage pollution, which still remains unsolved, although exhaustive investigation by the International Joint Commission resulted two years ago in a plan which, by reason of its heavy cost on the cities of Buffalo, the Tonawandas and Niagara Falls, as well as La Salle village, is apparently being "side-stepped" by those municipalities, was again discussed by City Engineer T. W. Barrelly, of Tonawanda, at the National City Planning Conference, held a couple of months ago in Niagara Falls.

Mr. Barrally recited the conditions affecting the situation, and found two methods of relief. They were: First, preliminary treatment of the sewage previous to its discharge into the river; second, removal of sewage by diversion to Lake Ontario.

Discussing diversion project, Mr. Barrally dismissed the proposition of an open canal along the margin of the river on account of prohibitive cost unless it were possible to take advantage of the difference in elevation of the lakes for developing water-power. A plan to construct a marginal sewer in a deep tunnel extending from the Tonawandas to Lake Ontario was advocated by the speaker.

"In making a preliminary study of the sewage disposal problem of the Niagara frontier for the pure water committee of the Tonawanda Chamber of Commerce," he said, "I have developed a plan for a marginal sewer in a deep tunnel extending from Tonawanda to Lake Ontario. There exists at the present time the old Erie canal running along the margin of the Niagara river from Buffalo to Tonawanda, and now substantially abandoned as a canal. The new barge canal route utilizes the river from Buffalo to the mouth of the Tonawanda creek at Tonawanda. At present a part of the sewage of the city of Buffalo enters the canal, including the Hertel avenue trunk sewer.

"This canal would be utilized as a drainage canal from Buffalo to Tonawanda, where it would drop about 275 ft. into the tunnel and develop water power. A similar development may be carried out at La Salle at Cayuga creek outlet. The tunnel would be about 21 miles in length and of sufficient capacity to dilute the sewage in accordance with the standards required.

"Increased dilution is secured at intervals along the route by this project and thus ample provision made to avoid the creation of nuisance along the route or at the lake. Accurate figures of cost can be made only after extensive surveys and borings and detail designs. Assuming that the tunnel is in rock, a tunnel 20 ft. in diameter could probably be constructed for $125 per ft., or a total cost of about $13,000,000 for the tunnel. Changes at the cities to make connections with the canal and tunnel for the existing sewerage systems, and power houses, machinery, etc., would cost about $7,000,000 additional, or a total of $20,000,000 for the entire project.

Water-power Development

"Assuming a diversion of 4,000 c.f.s., representing a dilution of 4 c.f.s. for each 1,000 of population, and based on a total population of 1,000,000, a head of 275 ft., and a turbine efficiency of 80%, we get a total of 100,000 h.p.

"Distributing this over the entire cost of the project, which may be as high as $20,000,000, would give a cost of $200 per horsepower.

"Since this power may be ultimately sold under a 40% load factor and to the extent of about 200,000 h.p. on this basis, we would have $100 per horsepower delivered to consumers, for the cost of the entire project.

"Probable yearly cost for power development:—

Interest on $2,000,000 at 4½%	$ 900,000
Depreciation	200,000
Other expenditures	250,000
Sinking fund @ 4%	132,000
Total	$1,482,000

"Cost per horsepower reckoned as 24-hour, seven-day power, $14.82 per horsepower per year, or if reckoned on 11 hours per week day, or under a 40% load factor, the cost would be about $7.50.

"The full income would not, of course, be attained for several years. These figures are approximate and are only given because they indicate the financial advantages possible in comparison with a sewage treatment project.

"A large part of the profit on the investment would be indirect, resulting from the more rapid growth of the cities due to power development, and consequent employment of more men and building up of industrial communities.

"This solution is attractive because it would accomplish two most desirable things, the diversion of sewage from the river and income to carry the financial burden of the project.

"Whatever method is adopted should be undertaken under state or federal regulation. It would be possible, however, to form all the municipalities and towns within the area to be served into a sanitary district, in the same manner as was adopted at Chicago in carrying out the Chicago drainage canal project."

Objections to Arthur Young Co.'s Classification

Report to Dominion Government Fails to Group Engineering Service Along Orderly Lines and Provides Too Narrow Limits for Promotion and Inadequate Compensation—Open Letter from the Chairman of U.S. Engineering Council's Committee on Classification and Compensation

SERIOUS objections are being raised by many engineers in the employ of the Dominion government to the classification and schedule of compensation recommended to the government by Arthur Young & Co., of Chicago, Toronto and New York. These objections have been well summarized in the following open letter addressed to Alfred D. Flinn, secretary of the U.S. Engineering Council, by Arthur S. Tuttle, chairman of the Engineering Council's committee on classification and compensation of engineers:—

"From time to time within the last few weeks, you have forwarded to me various letters addressed to you concerning the proposed 'Classification of the Civil Service of Canada' as recommended by Arthur Young & Co., of Chicago, Toronto and New York. The copy of this classification, which was also received, indicates that its preparation was authorized by the Canadian parliament and that the work was done under the direction of the Civil Service Commission of Canada.

"Your correspondents offer objections to the classification, particularly on the ground that the compensations proposed for higher grades of service are inadequate. In view of the investigation now being made on behalf of Engineering Council as to the classification and compensation of engineers in federal, state, municipal and railroad service, this report is of more than usual interest, and especially so since council's committee is informed that Arthur Young & Co. are performing a similar service for the U.S. congressional committee on reclassification and compensation of government employees, including engineers.

Recommend Seven Professional Divisions

"Engineering Council's committee on classification and compensation for the state and municipal services has tentatively proposed that all positions in these services be limited to 13 in number, of which 7 are distinctly professional, while the remaining 6 are in a class directly leading to professional work, but not necessarily of a professional character.

"In the questionnaire recently issued by the committee, the views of the responsible heads of the services affected are being sought, and in the responses which have been received up to the present writing, there has been practically unanimous agreement on the classification. The inquiry has not progressed far enough to warrant any expression as to the views concerning compensation other than to say that there is an unquestionably strong belief that if the engineering service is to be maintained on a proper plane, there must be a very substantial increase in pay.

No Attempt to Standardize Titles

"The Canadian report appears to cover every position in the civil service. It is arranged alphabetically, and in the absence of grouping, a complete analysis of the engineering service involves a task of magnitude greater than I have found time for. I have attempted, however, to make such examination as time permitted, and am impressed with a belief that the objections raised are well found.

"No attempt seems to have been made (by the Canadian report) to standardize titles. Consequently there are in the engineering service at least 157 independent titles as compared with the 13 titles proposed by our committee. It is recognized that qualification of a general title to show the nature of the service rendered is quite proper, but in the judgment of the writer there is no reason for treating similar positions as entirely unrelated and as warranting entirely independent specifications.

"The report states that the compensations proposed are intended for 'normal times,' and the pending restoration of such times, the rates recommended should be 'supplemented by a bonus,' but no information appears as to the magnitude of the bonus.

"From my study of the report it would appear that the groups and ranges of compensation, tabulated as far as practicable under the classification tentatively proposed by Engineering Council's committee are about as follows:—

TABULATION OF TITLES AND SALARIES FOR ENGINEERS IN CANADIAN CIVIL SERVICE REPORT UNDER CLASSIFICATION PROPOSED BY COMMITTEE OF THE U.S. ENGINEERING COUNCIL

Tentative Classification of Positions in State and Municipal Service Proposed by Engineering Council's Committee on State and Municipal Service.	No. of Titles Provided in Proposed Canadian Classification.	Salary Range Proposed for Canadian Service. Usual. Min.	Usual. Max.	Extreme. Min.	Extreme. Max.	Qualifications Proposed for Canadian Service.
Consulting Engineer	1	$6,000	.....	.....	.....	Professional Engineer, 12 years' experience (7 in charge).
Chief Engineer (major work)	5	6,000	.....	$4,800	.....	Professional Engineer, 7-12 years' experience (3 to 7 in charge).
Chief Engineer (minor work)	7	3,900	$4,800	3,600	6,000	Professional Engineer, 7-12 years' experience (3 to 7 in charge).
Chief Engineer—Deputy	8	3,900	4,800	3,600	5,700	Professional Engineer, 7-12 years' experience (3 to 7 in charge).
Engineer	37	3,300	4,020	3,000	4,500	Professional Engineer, 5-10 years' experience (2 to 5 in charge).
Senior Assistant Engineer	40	2,640	3,000	2,400	3,480	Professional Engineer, 3 years' experience (2 to 3 in charge)
Assistant Engineer	23	2,100	2,580	2,040	3,120	Professional Engineer, 3 years' experience.
Junior Assistant	15	1,680	2,040	1,680	2,160	Professional Engineer, 2 years' experience.
Senior Draftsman	..	.....	.....	Included in Professional Service.		
Draftsman	8	1,260	1,560	.....	.....	3 years' experience.
Junior Draftsman	4	900	1,200	.....	.....	2 years' experience.
Chief Instrumentman	..	.....	.....	Included in Professional Service.		
Instrumentman	5	1,260	1,560	.....	.....	3 years' experience.
Rodman	4	900	1,200	.....	.....	2 years' experience.

Sept 4, 1919

"In general, promotion through most of the grades is by increments of about $120, the minimum and maximum rates of each being respectively higher and lower than the rates fixed for the grades below and above, this resulting in a comparatively small salary range for each position, and in this respect corresponding with what seems to have been the general practice heretofore. This treatment is one which it would seem desirable to modify to the end that the relative ability and experience of men performing similar work may be given adequate recognition.

"Exceptions are noted in the case of 'Topographical Engineer,' where a salary range of from $2,160 to $3,120 is proposed, and in the case of promotion from 'Junior Electrical Engineer,' at a maximum salary of $1,980 to 'Electrical Engineer,' with a minimum salary of $2,640, each of the two latter grades having an extreme salary range of only $360. In the case of 'Chief Draftsman,' 'Structural Engineer,' and 'Chief Topographical Engineer' maximum salaries are proposed of $3,000, $3,240, and $3,840, with no provision for promotion to other engineering grades, although for each position the qualifications required are such as to indicate ability to progress to high positions in the service.

"The table also shows that only 6 engineering positions are open to compensation at a rate of more than $6,000 per annum.

"It would seem to the writer that this report is open to serious criticism on the grounds that it fails to group engineering service along orderly lines, that it provides too narrow limits for promotions within a grade, and that the compensation proposed for all grades, is inadequate for the service rendered. The latter criticism seems particularly pertinent in comparison with the rates now being demanded by organized labor. The practicability of properly meeting present-day conditions by the addition of a 'special war bonus' to the proposed rates in order to meet the present high cost of living is also to be questioned on the ground that, and as set forth in the circular letter issued by Council's committee on classification and compensation of state and municipal engineers, the 'revolutionary change in the cost of living' is one which 'unless modified by further economic disturbance is likely to be permanent or to continue for a long time to come.'"

MUNICIPAL BUREAU'S APPROVAL OF PLANS

Legislation Requiring Same is Recommended by the Ontario Municipal Association at Annual Meeting Held Last Week in Toronto—Other Resolutions Adopted

At the annual meeting of the Ontario Municipal Association, held last week in Toronto, a number of resolutions were adopted, and the executive committee was requested to prepare bills, embodying the spirit of the resolutions, for presentation to the Ontario legislature. Among the resolutions were the following:—

(1)—Whereas municipalities are, from time to time, called upon to undertake municipal works which demand high-priced expert skill and experience; and whereas the financial standing of many municipalities require careful and conservative consideration when large expenditures are involved; therefore resolved,—that all by-laws, plans and specifications providing for the construction of permanent improvements and the issue of debentures therefor, should be approved by the municipal bureau.

(2)—That the legislature of Ontario, and the department of highways, be respectfully requested to enact such legislation as will provide for the standardizing and erection of danger signals on roads and highways throughout the province.

(3)—That the Dominion Railway Board provide that at points where gongs are used, or are necessary as warning at railway crossings, these said gongs be placed at both sides of the said railway crossings, on the highway, at a distance of not less than 50 ft. from the railway.

(4)—That rural municipalities be granted the power now enjoyed by urban municipalities of regulating the opening of sand and gravel pits and the removal of sand and gravel from pits already in operation.

(5)—Whereas dissatisfaction has been expressed by citizens with the present form of municipal government; and whereas more centralized control of all civic activities by one governing body is desired, either by what is commonly called commission government or by some method of co-ordinating the existing councils, boards and commissions; be it resolved that the provincial legislature be petitioned to secure a report on improvement of the present municipal government system which will best conform to Ontario ideals of government and satisfy modern demands.

EDUCATION OF HIGHWAY ENGINEERS

By Arthur H. Blanchard
Professor of Highway Engineering, University of Michigan

Highway officials, progressive educators and many prominent business men realize that a serious condition will confront the United States and Canada if graduates of our technical schools are not properly trained in highway engineering. The phenominal development of highway transport has created a demand for efficient highway improvement which can only be satisfied by placing highway work in the hands of competent engineers.

Thoroughly trained and experienced highway engineers are needed to occupy the innumerable positions connected with the administration, financing, design, construction and maintenance of the 2,500,000 miles of rural highways and the thousands of miles of streets in the municipalities of the United States and Canada in order that highways may efficiently serve economic, social, transportation, agricultural, industrial, commercial and military requirements. Highway appropriations will increase rapidly during the next five years, as is indicated by the 1919 appropriations of $500,000,000 in the United States and a relatively large amount in Canada, for highway improvements, and a wide-spread demand for the construction of a system of 50,000 miles of national highways by the United States government under the direction of a national highway commission.

Estimates made this year by the United States Bureau of Public Roads disclosed a remarkable field of opportunity for highway engineers, as investigation showed that for federal and state highway work alone, exclusive of cities, counties and towns, there are required 122 chief executives and administrators; 360 division engineers of the federal government, division chiefs of bureaus, division chiefs of highway departments, district engineers of highway departments, etc.; 3,630 supervising engineers and chiefs of party; and 6,350 junior engineers, rodmen, chainmen, draftsmen and others.

The consensus of opinion of eminent highway engineers and educators is to the effect that highway engineers should have the broad foundation which the four-year course in civil engineering gives. The Asphalt Association takes the definite stand that as much time should be given to the essentials of highway engineers as is given to sanitary, hydraulic or railroad engineering. The association will devote its educational campaign especially to institutions where either no courses or very short courses in highway engineering are given. The Asphalt Association has found that only 25 of the 93 colleges investigated give a satisfactory fundamental training in highway engineering as a part of the civil engineering course.

The waste of millions of dollars annually in the United States will continue until the profession of highway engineering is placed on the same basis as structural, hydraulic, sanitary and other branches of civil engineering. England and France have seen the light. As a result, efficient highway engineers are retained in office, methods of construction and maintenance suitable for traffic requirements are employed, and as a consequence the public funds are wisely and economically expended.

CONCRETE RAILWAY TRACK SUPPORT

VARIOUS types of concrete track construction that have been installed on United States railways were described by A. C. Irwin, engineer of the Structural Bureau of the Portland Cement Association, in a paper recently presented before the American Concrete Institute. The following excerpts are from Mr. Irwin's paper:—

Street Car Track Construction at Anderson, S.C.—A type of track construction designed by E. R. Horton, Jr., and used in Anderson and Greenville, S.C., for street car track construction is shown in Fig. 1. This is in reality the longitudinal girder principle. The rails are embedded in the concrete and rest on a continuous plate. Rail clips and hook bolt anchors are used.

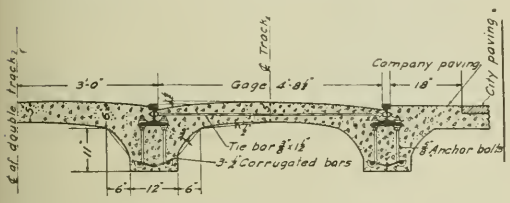


FIG. 1—CONCRETE STREET RAILWAY TRACK CONSTRUCTION AT ANDERSON, N.C.

Recent inquiry in regard to the condition of this track after four years' service indicated that the construction has been found satisfactory in every particular, that vibration has not caused deterioration of the concrete and that even the paving between the tracks is in good condition. To adapt this design to steam railroad requirements, states Mr. Irwin, it would only be necessary to deepen the girders and widen them out at the base for additional bearing area and to change the paving in between tracks to diaphragms at intervals below the base of rails.

Installation on Long Island R.R. at Jamaica, N.Y.—Examples of the type involving a concrete slab carrying ballast in which ordinary track ties are embedded is shown by Fig. 2. This construction was placed under 49 crossings, switches and slips on the Long Island R.R. at Jamaica, N.Y. The work was put in during the winter of 1912-13 on embankments composed of sand averaging 20 ft. high. Portions of the slabs were placed without allowing time for the embankment to settle and the traffic over these slabs has been extremely heavy from the day they were put in, running as high as 1,300 train movements per day. After 3½ years the general manager of the Long Island R.R., J. A. McCrea, reported that there had been practically no maintenance on the track. Mr. McCrea goes on to say that the great advantage of the slab is that the bearing surface on the natural ground is increased about three times over the usual method without taking into consideration its continuity and that examination of these experimental slabs showed that there

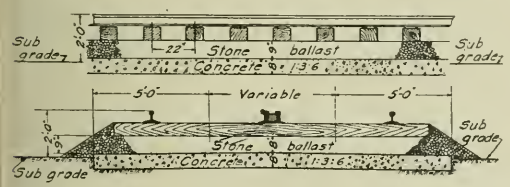


FIG. 2—SECTION OF CONCRETE SLAB, JAMAICA IMPROVEMENT, LONG ISLAND, R.R.

were no cracks, at least in the vicinity of the points of examination. It will be noted that these slabs are not reinforced and that they are only 8 in. thick. It should also be noted that they have been subjected to the pounding that occurs at crossings and frogs.

It has become very common practice to use reinforced concrete slabs to form the decks of deck girder railroad bridges. These slabs are usually about 1 ft. thick, 5 ft. long and span the distance between girders. The ballast is retained by curbs at the ends of the slabs. The testimony of railroad officials in regard to this construction is that when

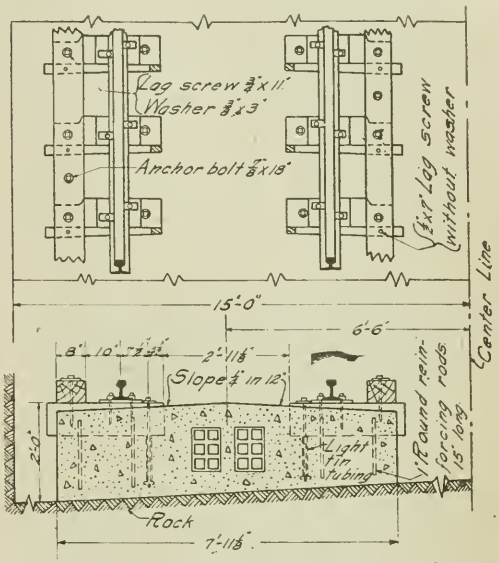


FIG. 3—CONCRETE TRACK CONSTRUCTION USED IN BERGEN HILL TUNNEL OF D.L. & W. RY.

the ties are once embedded they stay in place and that maintenance is very greatly reduced.

Bergen Hill Tunnel Tracks, Delaware, Lackawanna & Western R.R.—The new Bergen Hill Tunnel of the D., L. & W.R.R. was completed in 1909. The tracks in this tunnel are carried on reinforced concrete slabs, details of which are shown in Fig. 3. This construction was designed by Lincoln Bush, who was then chief engineer of the railroad.

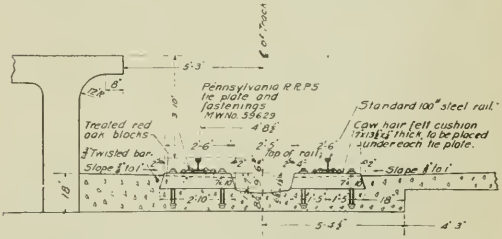

Pennsylvania R.R. P.S. tie plate and fastenings Wrot. Iron 5⅜x29
Standard 100# steel rail
Treated red oak blocks
Cow hair felt cushion 1"x3½" thick, to be placed under each tie plate.
¾" Twisted bar
Top of rail
Slope ½" to 1"
Slope ½" to 1"
18"
5'-3"
5'-5½"
4'-3"

FIG. 4—CONCRETE TRACK CONSTRUCTION AT PENNSYLVANIA TERMINAL, NEW YORK

Under date of October 3, 1916, Mr. Bush reported as follows in regard to this construction:—

"It was completed and turned over for service in February, 1909. The roadbed in the new tunnel has stood up exceedingly well and none of the creosoted tie blocks have been renewed so far as I have learned on recent inquiry.

"My idea in getting out this design was that if railroad track could be made perfectly rigid and unyielding, there would be no pounding or unusual stress in rail. The roadbed in the new tunnel referred to has been in service under the heaviest kind of traffic since February, 1909, and

has demonstrated fully that if track is made perfectly rigid that it will stand up against the heaviest kind of traffic.

"I am convinced that with a perfectly rigid surface there will be no pounding and serious damage in railroad track unless some defect existed such as flat wheels. Such conditions, however, are corrected when they do arise with the railroad rolling stock. I have felt for some time that with the heavy rolling stock that the best ballasted track had practically reached the limit of loading and if the heavy rail is used the supports of same on tie ballasted track is not like the abutment of a bridge as ties yield causing deflections in the rails and it will be found that even with a heavier rail the stress may be greater in the rail than with a light and less stiff rail section which lends itself more readily to deflection."

The tie blocks are notched at the outer end to form a shoulder and are in place when the concrete is poured. A wedge is driven in between the concrete and the opposite side of the block, preventing the block from being disengaged from the shoulder under traffic. The blocks are replaced by moving the wedge, pushing the block longitudinal

FIG. 5—CONCRETE TRACK CONSTRUCTION ON CHICAGO JUNCTION RY.

of the track so as to disengage the shoulder and slipping it from under the rail. This work can be done by one man.

Track Construction in Pennsylvania R.R. Terminal Station, New York.—Fig. 4 shows the concrete track construction in use in the Pennsylvania R.R. terminal station, New York. A single track length of 14,600 ft. of this type was laid adjacent to platforms. In general the concrete was laid on the rock of the subgrade, but where the subgrade consisted of loose rock backfilling the concrete slab was reinforced. A length of 720 ft. of similar construction is in use in two of the East River tunnels (Nos. 1 and 2) immediately east of the Long Island shafts. These sections of track are subjected to high-speed traffic.

The Chicago Junction Ry. Track.—In 1911, 500 ft. of concrete track support was installed on the Campbell Ave. line of the Chicago Junction Ry., where it crosses the Illinois and Michigan Canal. Details of this construction are shown by Fig. 5. This construction is patented by Louis H. Evans, of Chicago, and was installed on the Chicago Junction Ry. as an experimental stretch of track, the location being se-

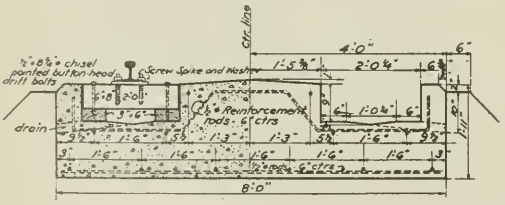


FIG. 6—TYPE 1 OF NORTHERN PACIFIC RY. CONCRETE FOUNDATION

lected with a view to subjecting it to very heavy and continuous traffic. A majority of the stock trains going to the Chicago Stock Yards pass over this concrete track. These trains are usually drawn by heavy locomotives and make more than usual freight train speed. A thorough examination of the track indicates that although transverse cracks appear in the portion of the concrete above the base of rails, these cracks do not extend down into the supporting slab. In fact, the construction seems to have suffered practically not at all from the heavy traffic which it has carried. G. W. Hegel, chief engineer, the Chicago Junction Ry., advises that there has been no maintenance on this stretch of track excepting to renew a few of the tie blocks. The tie blocks are spaced 34 in. centres. So great a spacing would not be allowed with the usual ballast and tie type of con-

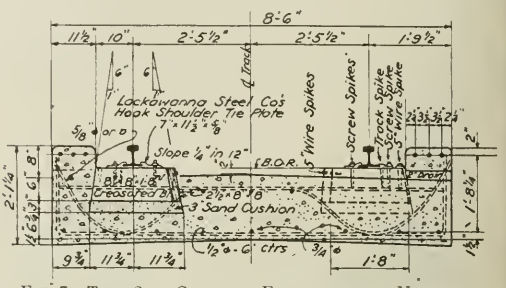


FIG. 7—TYPE 2 OF CONCRETE FOUNDATION ON NORTHERN PACIFIC RY.

struction, but with this unyielding track foundation such a spacing has been found to be practicable, since the majority of the deflection in railroad track is due not to the lack of rail stiffness but rather to the lack of any sort of rigid support. Mr. Evans sums up the comparison of this construction with the usual type as follows: Weight of train distributed over 3 times the surface saves $\frac{9}{10}$ of the ties. The cost for 20 years is one-fourth of rock ballasted track.

Northern Pacific Ry. Track.—On the Point Defiance Line of the Northern Pacific Ry., in the State of Washington, there was constructed about five years ago, 2,000 ft. of track with a concrete slab foundation. Details of the three types used are shown by Figs. 6, 7 and 8. In general, these types consist of a reinforced concrete slab provided with recesses or troughs for the reception of wood blocks or stringers to carry the rails. Details of Type No. 1 are shown by Fig. 6.

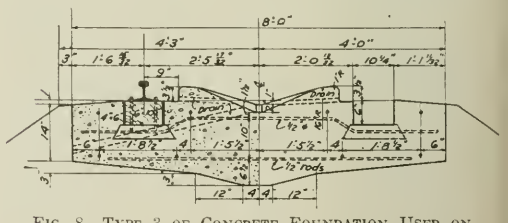


FIG. 8—TYPE 3 OF CONCRETE FOUNDATION USED ON NORTHERN PACIFIC RY.

The short tie blocks rest on two longitudinal 3 by 6 pieces in the bottom of a trough at each side of the slab. The space in between tie blocks is filled with ballast. Drainage of the troughs is provided at intervals. There is a total of 594 ft. of Type 1 construction. The slabs are cast in lengths 16 ft. 5½ ins.

Type No. 2, Fig 7, is 6 ins. wider than Type No. 1 or No. 3, and is distinguished by a curb practically equal to height of rail along each side. There is also 594 ft. of single track of this type in service. In this type recesses are cast into the slab into which the tie blocks are placed and wedged into position. The rails are fastened in the usual way with tie plates and screw spikes. In the bottoms of the tie block recesses 3 ins. of sand is placed to afford a cushion. On top of this sand cushion the creosoted tie block is placed and wedged at the inner end of the block. L-shaped malleable shims are used at the other end of the tie blocks with one leg of the L resting on top of and fastened to the tie block. This allows lining and gauging of track. These slabs are cast in widths of 32 ft. 11 ins.

Type No. 3 is shown in detail on Fig. 8. The distinguishing features of this type are that the concrete is carried up 3½ ins. near the inside of each rail and sloped to centre of track for drainage, and that the rail rests directly on a continuous longitudinal stringer of 6 by 10 ins. creosoted fir. These stringers are fastened at intervals by long lag screws driven into wood anchor blocks embedded in the slab. The slabs have a depth of 18 ins. at the centre and were moulded in lengths of 16 ft. 5½ ins. There is a total of 810 ft. single track of Type 3.

While neither the first cost of the concrete track foundation on the Northern Pacific R.R nor the annual maintenance cost of it are available, yet the railroad company's officials say that the maintenance has been far below that of track of the ordinary type of construction on the same line. The greater part of this maintenance concerns the wooden blocks to which the rails are fastened, especially with Type 3. In

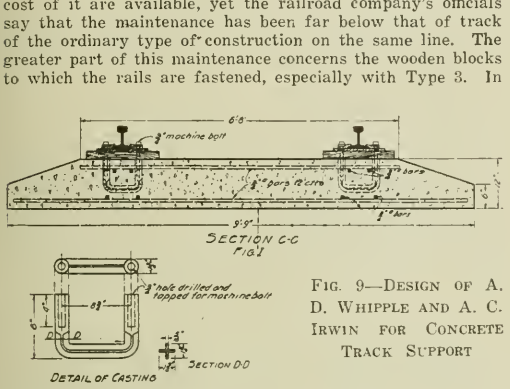


FIG. 9—DESIGN OF A. D. WHIPPLE AND A. C. IRWIN FOR CONCRETE TRACK SUPPORT

this type the key blocks out in spite of the fact that they are spiked to the tie blocks.

New Design for Concrete Track Support.—Fig. 9 shows a suggested design for concrete track support prepared by A. D. Whipple and A. C. Irwin. The form work required for this slab is of the simplest sort. The design of the slab is based on Cooper's E-60 loading with 100 per cent. impact. This design does not require any radical departure from the usual type of rail fastenings, that is, a rail clip is used similar to those now standard. There is, however, a very great difference between this rail fastening and the usual cut or screw-spike used with wooden ties. In this concrete design a U-shaped casting is embedded in the concrete and the upstanding legs of the U are tapped to receive the threaded end of holding down bolts which pass through the rail clips, tie plate and tie block. A positive fastening which has great strength against lifting the rail is thus secured. The use of a block of wood under the rail in this design is at once a concession to the prevalent idea that some elastic medium must always intervene between a track rail and a solid foundation and a means for easy adjustments of the rail both vertically and horizontally to provide for whatever inequalities may exist in the top of the slab either at the time of placing or subsequent thereto. The latter is the only sufficient reason for using this tie block, and where the slab is placed on a well compacted subgrade the rail may be anchored directly to the concrete, with possibly the intervention of a longitudinal steel plate between the rail and the concrete surface, thus affording the rail a continuous support. In the latter case drainage would be taken care of by finishing the slab to a slight pitch between the rails and furnishing openings beneath the rails at intervals.

City Commissioner Mackie, of Moose Jaw, Sask., has prepared a statement showing the operation of the Light and Power Department and the Water Works Department for the first six months of this year. The Light and Power deficit was $200.70 and the Water Works deficit, $1,444.94. At the beginning of the year Mr. Mackie had estimated that the Light and Power Department would just about pay its own way for the ensuing six months and that the Water Works deficit would be over $9,000.

FINE-GRAINED CONCRETE SANDS

By F. E. Giesecke
Professor of Architectural Engineering, University of Texas

THE engineering division of the University of Texas is planning a systematic study of sands with reference to their value in concrete construction, because we believe that there are many deposits of fine-grained sands which are generally considered too poor to be used in concrete construction and which have to be rejected under most specifications in force at the present time, but which, with proper care, might possibly be used to advantage, thereby saving considerable sums of money. We were led to this conclusion by a consideration of the following:—

We have a considerable quantity of an extremely fine-grained sand to be tested; the sand has the following sieve analysis:—

Retained on 200-mesh sieve	78.0%
Retained on 100-mesh sieve	43.0%
Retained on 65-mesh sieve	4.8%
Retained on 48-mesh sieve	3.0%
Retained on 35-mesh sieve	None

Among the current specifications for concrete sand are the following:—

(A)—Sand shall grade from fine to coarse; all shall pass the ¼-in. sieve; not more than 28% shall pass the 50-mesh sieve, and not more than 10% the 100-mesh sieve.

(B)—All sand shall pass the ¼-in. sieve; not more than 75% and not less than 40% shall pass the 20-mesh sieve; not more than 30% and not less than 2% shall pass the 50-mesh sieve; not more than 6% shall pass the 100-mesh sieve.

(C)—At seven days a 1: 3 mortar should have a strength at least equal to that of Ottawa sand mortar; the sand shall be rejected if the strength is less than 70% of that of the Ottawa sand mortar.

The sand referred to would therefore have to be rejected under specifications A and B; it would also have to be rejected under specification C, because when tested in mortar it developed a tensile strength of 200 lbs. per sq. in. at seven days in a 1: 3 mortar as against a strength of 293 lbs. for Ottawa sand mortar.

It may be of interest to note that this sand has a "fineness modulus" of 0.46 according to the system proposed by the Lewis Institute of Chicago, and that Bulletin No. 1, issued by the Lewis Institute in April, 1919, suggests on page 12 that "sand with a fineness modulus lower than 1.50 is undesirable as a fine aggregate in ordinary concrete mixes. Natural sands of such fineness are seldom found." So the sand also fails to meet the requirements proposed by the Lewis Institute.

In spite of the fact that the sand failed to pass any of the current specifications, concrete made with the same was fairly good, as will be seen from the following:—

The concrete was made up with a blend cement and with Colorado river gravel carefully screened and rescreened so as to contain no material finer than ¼-in., and in the following proportions:—

Blend cement	14.3%
Fine grained sand	14.3%
Gravel, ¼ to ¾ in.	35.7%
Gravel, ¾ to 1¼ ins.	35.7%
	100.0%
Water	11%

The resulting mix had a thick, flowing consistency. The following unit strengths were found at an age of 28 days in 6 by 12-in. cylinders:—

Rodded eight times, 30-minute intervals	3,420
Rodded eight times, 30-minute intervals	3,240
Rodded eight times, 30-minute intervals	3,110
Rodded only slightly just after moulds were filled	2,530
Rodded only slightly just after moulds were filled	2,500
Rodded only slightly just after moulds were filled	2,440

(By "rodding" concrete we mean pushing a pointed iron rod into the concrete to allow the excess water and the entrapped air to escape upward and to compact the aggregate. See article in the August 14th, 1919, issue of *The Canadian Engineer*, page 217.)

The above-mentioned strengths compare favorably with those of other concretes: for example:—

Compared with the Lewis Institute expression for the strength of concrete ($14{,}000 \div 7^{\frac{5}{8}}$), this concrete should have a strength of about 1,500; it is apparent that the three rodded specimens were about 117% stronger and the three plain specimens about 65% stronger.

Compared with the best concrete prepared in our laboratory with carefully graded Colorado river sand and gravel and with the same percentage of cement (about six sacks per cu. yd.) and thoroughly rodded, which developed a unit strength of about 4,700 lbs. per sq. in., this concrete was about 69% as strong.

Compared with concrete recently used in a reinforced concrete building, and prepared of good materials under specifications calling for a 1:1½:3 and a 1:2:4 mix, and developing the following strengths in 28 days: Plain concrete, 1,568 and 1,208 lbs. respectively; thoroughly rodded concrete, 2,293 and 2,215 lbs. respectively, this concrete is about 50% stronger.

We wish it understood in this connection that we are not advocating the use of such extremely fine sand in concrete construction, but we believe that there are many deposits of sands which are too fine to pass current specifications and yet sufficiently coarse to produce good concrete if used in the best possible manner, thereby saving considerable sums of money in concrete construction near such deposits, and that this subject deserves careful investigation.

Your attention is invited to the fact that the mix described above was about a 1:1:5 mix and it may not be amiss here to call attention to the common but erroneous belief that a 1:2:4 mix will always produce good concrete.

According to Fuller's maximum density curve, a 1:2:4 mix is good when the fine aggregate grades from very fine to ¼-in., and when the coarse aggregate grades from ¼-in. to 1¼ ins.; when either the fine or the coarse aggregate grades differently, a mix other than 1:2:4 should be used for 1:6 concrete.

INCREASE OF RAILWAY MILEAGE SINCE 1835

THE history of railway mileage in Canada, less trackage rights, is brought to the year 1918 in the following table, taken from the report of Railway Statistics for the year ended June 30th, 1918, issued by the Department of Railways and Canals:—

Year.	Miles in operation.	Year.	Miles in operation.
1835	0	1868	2,270
1836	16	1873	3,832
1846	16	1878	6,226
1847	54	1883	9,577
1850	66	1888	12,163
1851	159	1893	15,005
1852	205	1898	16,870
1852	506	1903	18,988
1854	764	1908	22,966
1855	877	1914	30,795
1856	1,414	1915	35,578
1858	1,863	1916	37,434
1859	1,994	1917	38,604
1860	2,065	1918	38,879
1865	2,240		

T. Kennard Thomson, of New York City, who is a well-known consulting engineer and a graduate of the University of Toronto, has planned a six-track belt line railway to run around Manhattan Island, at a cost of $250,000,000. Mr. Thomson states that 200 business men are willing to finance the work at no cost to the city.

NEW STONE AND GRAVEL ROADS INSURED BY SURFACE TREATMENT

By F. H. Gilpin
Engineer, Asphalt Sales Department, The Texas Co.

EVERY form of construction dedicated to public use and comfort bears some type of insurance against its own particular agent of destruction, except those means of communication which are open to the free and unlimited use of all—our highways and by-ways. Whether it be a main artery of travel between large centres of industry, or a minor capillary sufficient for the needs of a small community, some insurance should be created to ensure to all a longer, useful life of these means of communication upon whose very existence is dependent the life, health and happiness of the inhabitants.

Particularly the minor arteries are of interest, as, in reflection of a universal demand for permanent lines of communication, a program of construction has been evolved that will in a few years bind the main centres with roads that will carry practically unlimited traffic. Available funds do not permit, nor does reason demand, that all lines of communication be so established. Already by far the greater mileage of our secondary roads are being subjected to a class and amount of traffic far beyond that which they were intended to withstand; and besides, the public demands that they be maintained and insured against the future destruction.

Destructive Forces

How do the main forces of destruction act, and how should they be insured against? Primarily, through the erosion of the surface by the forces of nature and traffic; secondarily, by the destruction of the wearing course, and finally, the destruction of the base through the same agencies aided in increasing ratio as the avenues of attack are opened. How can these agencies of destruction best be insured against? By the creation of a greater bond in the surface that at the same time renders it more tenacious, adherent, resilient and waterproof.

This is attempted in many ways: By the use of water, solutions of various chemicals, deliquescent salts, paraffine base oils, tar distillates and asphalt base oils.

What are the merits of the various means? Water obviously is temporary in character and requires repeated applications, in some cases many times daily. Deliquescent salts are dry weather remedies, and their very nature tends to wash them out in heavy rains. The same argument applies to chemical solutions. Paraffine base oils are more or less odorless and colorless but their lack of binding qualities and tendency to run off the road and be washed off by heavy rains, place them in a class useful only as temporary dust layers requiring duplication of seasonal routine.

Tar distillates are the first that come within the class that in addition to dust laying, form a waterproofing adhesive mat on the surface of the road, and, being marketed in various grades, permit of several degrees of intensity of application, both with or without prior heating.

Asphaltic Oils

Asphaltic oils permit of a wider range of surface treatment than any other type of material for this purpose. Having a minimum susceptibility to temperature change, the protective coating formed does not become brittle in cold weather nor too soft in hot, thus ensuring a waterproof, resilient surface throughout the year. Available in all grades from a light dust-laying material to the heaviest which requires both heat and pressure for application, practically any type of road from earth to new macadam can be protected against erosion and made to render a longer serviceable life to the property owner and the user.

The more open the surface of the road, the more recent the construction, the greater is the ability of the road to take a heavier surface treatment with consequent increased length of time between applications and satisfactory results. Oiling a road will not restore an eroded surface, nor will it re-establish a destroyed crown, but where the surface is not badly worn, a treatment with a hot application

and clean stone screenings or slag grit will re-establish a wearing surface which will withstand moderate traffic for several years.

Don't Wait Too Long

The fact that a road is newly constructed and needs no repairs should be only an added incentive to protect the surface before the forces of destruction have full sway and put the road into such a condition that oiling of the surface preserves only the portions that remain intact, and permits the impact of heavy moving vehicles to enlarge any potholes or depressions, so that the effect of the oiling becomes nullified. The success will be no greater than that of trying to stop holes in a roof caused by dry rot or physical damage, by painting the remaining surface. The time to oil is now, before destruction starts, and repeat the treatment, according to the intensity desired, as required, successive treatments decreasing in intensity.

As in any material application, the best material applied to the purpose at hand in the most skilful and careful manner, gives the best appearance and the most lasting qualities. Oil that requires a small amount of heat to permit the most efficient operation of a pressure distributor, applied to a thoroughly clean, swept road, and covered with sufficient gravel or screenings to completely cover the surface immediately after application, has given complete protection against excessive rainfall by which untreated roads have been partially destroyed.

Objections Temporary

Objections as to odor and color of asphaltic oils are temporary and personal. The odor is slight at any time, and vanishes as the road dries. The color can only be objected to when tracked into the residences of the property-owners, and any oil (if of value as a binder), if permitted to adhere to other objects, will form a nucleous around which the objectionable particles of dirt will collect, whether the oil possesses a color or not.

At seashore or other resorts where unpleasant, personal contact with the new surface is an obvious objection, treatment early in the year would permit a finished surface to be presented during the season and would meet with the approval of all.

Where the road surface is of a material that is finely divided and does not permit of sweeping, oil containing a minimum of asphalt, lightly applied, will allay the dust for a season, though the protection against such traffic as a road so constructed should be called upon to stand is more nominal than real. The small degree of porosity and close formation of the surface prevents the absorption of any binder except such as can be carried by the lighter carrier in the oil.

As the character of the surface of the road changes so that a heavier oil can be applied, two light applications in a season permit a rapid drying of the surface and a penetration of the asphalt sufficient to reduce, to a negligible amount, the ability of traffic to pick up the oil.

HIGHWAY TRAFFIC REGULATIONS

SUGGESTED general highway traffic regulaions, accompanied by an interpretative bulletin, are now being sent out by the tens of thousands as a part of the campaign inaugurated by the U.S. Council of National Defense through its Highways Transport Committee, to the end that the number of accidents on the highways be decreased.

Police records, it is said, especially in recent months, emphasize the vital need for concerted action looking to the safety of life and limb, and intelligent study along the lines of simple and easily understood highway regulations.

The view of experts who have given the subject of traffic regulations extended study is that uniformity, especially as to the fundamentals in traffic regulation, is necessary if success in combatting this evil is to be in proportion to the need for the same.

The Council of National Defense believes it is possible, through the adoption very generally by municipalities of the suggested regulations which it is distributing to the public, to reduce to a most gratifying extent the number of accidents growing out of the rapidly increasing number of motor vehicles on the highways.

The key to the solution of the problem of how best to protect those travelling on the highways, especially in the cities and towns, both pedestrians and drivers of vehicles, says the council, is through education of the public. Once the standardization of highway traffic regulations is brought about through co-operation by authorities in the principal cities of the country, this education of the public as to the need for observation of rules laid down in these regulations, it is believed, may fairly quickly be brought about.

The regulations being distributed by the Council through its Highways Transport Committee stress the necessity for caution being exercised at crossings, roadway intersections and junctions, where most accidents occur. This caution implies extreme care on the part of drivers and constant watchfulness upon the part of both drivers and pedestrians.

MONTREAL AQUEDUCT ARBITRATION

City Must Pay $308,000 to the Cook Construction Co., Who Claimed $1,775,000—Company Is Held Responsible for the Break in the Concrete Conduit

CLAIMS aggregating $438,000 have been allowed against the city of Montreal by the award of the Board of Arbitration in the suit for $1,775,000 brought against the city by the Cook Construction Co. as damages for the cancellation of the aqueduct contract. Counter-claims to the amount of $130,000 were conceded by the board, leaving a balance of $308,000 to be paid by the city to the construction company.

The arbitrators were W. F. Tye, consulting engineer, Montreal; J. M. R. Fairbairn, chief engineer of the C.P.R.; and Aimé Geoffrion, K.C., Montreal.

The company originally claimed $1,900,000 and the city claimed $50,000, but these amounts were later reduced respectively to $1,775,000 and $412,000.

A feature of the arbitrators' judgment is that the Cook Construction Co. is held responsible for the break in the conduit, December 25th, 1913, when most of the people of Montreal were deprived of water for several days. On this account the city was awarded $81,889 as compensation for lack of precaution by the company.

In this portion of the award Mr. Tye dissented, but Messrs. Fairbairn and Geoffrion were of the opinion that the company is liable for the reason that it had been emphasized in the contract that the conduit was the sole source of water supply for the greater portion of the city of Montreal, and that extreme precaution would be required in connection with it, and that the contractor would be held responsible if he were to damage it.

Mr. Tye dissented on the ground that the city engineers had misled the company in regard to the reinforcement of the conduit, the tamping of the backfill, and the underdrain, and because the city had not informed the company of a washout that had occurred before the signing of the contract.

The largest individual item of damages awarded to the company was on account of delays. The amount claimed under this head was $600,000; the amount awarded was $215,881.

The agreement to arbitrate the differences between the company and the city was made nearly two years ago, and since then witnesses and experts galore have been called to enlighten the arbitrators regarding the responsibility for one of the biggest municipal tangles in which Montreal has ever become involved.

According to the terms of the arbitration, each party pays its own costs for legal advice and witnesses, while all other costs are equally divided.

PROBLEMS CONFRONTING MUNICIPAL ENGINEERS*

By Charles Brownridge
Borough Engineer, Birkenhead, Eng.

With the conclusion of the war there is much leeway to be made up, and arrears to be made good, and it is very desirable that—having regard to the altered conditions which now exist—we should closely consider how we can in future best plan and carry out our work, and what improvements in our methods we can with advantage adopt.

In work connected with the war, all branches of science were organized for one common aim, and I would express a hope that this principle should not be altogether abandoned, but that the system should, at least in part, be retained and continued, with its energies directed now to investigation and research for the improvement of the health and welfare of the community, and that the State should, either by direct action or generous subsidy to the laboratories of the various universities, foster and encourage experiment and research in order to ascertain the best methods and appliances to adopt to prevent and stamp out disease, and to discover new, and improve existing, materials and methods used in construction work.

The Supply of Materials

With reference to materials, we have in the past, while endeavoring to do our best with those to hand, been too content to accept the materials available. I feel sure that if the energy and ability of our chemists were directed in the right channels, they would be able to give us many improved and alternative materials suitable for our work, and devise methods to increase production and cheapen the cost of manufacturing or producing existing materials.

As engineers we would welcome the discovery of a cement having the combined merits of portland cement and bitumen, and satisfactory substitutes for wood, stone and bricks. I feel sure that, although the bricks at present manufactured are excellent, cheaper methods of manufacturing and burning could be devised.

Any and all efforts to ensure good buildings being erected and new work carried out at a reasonable cost will be to the material advantage of the State, and enable us to carry out more quickly the many and various works that are so urgently required, and so necessary in connection with our municipal work, to make our people healthy, and to keep them healthy and happy in the future.

The past has taught us many lessons from which we should now profit, and we should now, by taking a wide and generous view, so shape and design our work as to look well ahead and not only provide for the present, but have due regard to the changing conditions now existing and the consequent probable requirements of the future.

Labor Difficulties

The wave of industrial unrest now passing over the country is seriously affecting the work of our municipalities, and it will be necessary that we should carefully consider and review the position with a view to best overcoming the serious labor shortage existing, and adapting our conditions to meet the higher wages now ruling.

It is to be regretted that workmen, whilst justly and properly taking all means to assert their rights, do not in very many instances appreciate that they have in addition also their duties to themselves, their families, their work and to the State.

Good wages can always be justified if supported by good labor, but the present irregular time-keeping of many of our workmen is causing serious unnecessary difficulties and waste to arise. In my own case, I regret to say that since armistice day there has been amongst the men employed under my direction an average daily absenteeism exceeding 10 per cent., often causing necessary sanitary duties to be seriously prejudiced and affected. Unfortunately, this irregularity not only affects the work which should be done by those absenting themselves, but in many instances disorganizes and interferes with the arrangements necessary to be made in connection with all work, and causes serious loss and waste of time. If any steps can be taken to stabilize labor and make its service dependable—subject, of course, to justifiable absence owing to sickness—it would, I am sure, be welcomed by all having the charge and direction of work.

Use of Machinery Necessary

It will be necessary on financial grounds for the engineer carefully to consider what machinery and appliances can be installed to cheapen and expedite work, and to foster and further the employment of mechanical appliances for all work in which it is possible for it to be suitably and beneficially used, especially that which will tend to reduce the employment of unskilled labor, as, with the universal advance in education and learning, this branch of labor should be reduced to a minimum and its present members transferred to and trained in some branch of the arts and crafts.

The extent and character of the use of machinery in our work in future will no doubt be considerable, and its form and design offer a wide field to the ingenuity of the inventor, and, as progressive engineers, we should do all we possibly can to further its application and foster its invention. Most municipalities have already found it both economical and advisable to adopt mechanical haulage, and are considering the introduction of machines for the combined sweeping and collecting of refuse from the streets, and for excavating, filling and ramming trenches; a more extended use of mechanical mixers for concrete and tar-macadam; a more general adoption of mechanical means for lighting and extinguishing lamps and other numerous mechanical devices will be found necessary and desirable.

Institution Sparing no Efforts

The work of the municipal engineer is most wide in its scope, of a most varied character, and its duties onerous, calling for unremitting attention, care and thought, and it is therefore fitting that the Institution of Municipal and County Engineers are sparing no efforts to ensure that its younger members shall be properly educated and trained for their work, and have every facility for this purpose, and further to ensure that local authorities should only appoint properly trained engineers and surveyors at a proper and adequate salary; and, having regard to the great effect the work of the engineer and his assistants has on the prevention of disease and the comfort and health of the community, this excellent work will no doubt bear good and valuable fruit and enable the members of our profession to direct their endeavors in the most effective and productive way to carry on their duties.

*Excerpts from presidential address delivered before a Conference of Engineers and Surveyors held in connection with the Royal Sanitary Institute Congress at Newcastle-on-Tyne, Eng.

For five hours last evening, Toronto was without street car service, as 250 electrical workers of the Toronto Power Co. went on strike and stayed out until Manager R. J. Fleming wrote a letter to Mayor Church accepting, in its entirety, the report that had been made by a Board of Conciliation. The strike was unexpected and many street cars were stalled, unlighted, at street intersections.

The "Review of the Foreign Press," which has been published fortnightly for the past 2½ years by the General Staff of the War Office, London, Eng., has been discontinued, the last number appearing August 19th, 1919. Major Simnett, the editor, says: "Having regard to the cessation of war, it is obviously inappropriate that this work should be conducted under the auspices of the General Staff."

The Consolidated Iron and Steel Corporation, Ltd., has been incorporated with offices in Toronto. The company's officials state that the company owns two large deposits of iron ore lands, one of which is at mileage 182 of the Algoma Central Railway, and the other consists of 1,500 acres in the county of Leeds, Ontario, 25 miles north of Brockville. It is stated that the city of Brockville has offered inducements to the company to build a smelter there.

HIGH CONTRACT PRICES SHOULD LEAD NEITHER TO POSTPONEMENT NOR TO DAY LABOR*

IT is difficult to realize that the cost of road and street construction has doubled in five years. Consequently, when contractors bid twcie as high as in 1914, there is a strong inclination to reject all bids. In some cases this leads to postponement of the work till next year. In other cases it leads to construction by day labor. Whichever of these two courses is adopted there will be regret. Wages are rising and prices of materials show no sign of falling. Hence, contract prices are apt to be higher next year than now.

Work done by day labor is rarely done as cheaply as by contract. Usually, day labor work on roads costs fully 25% more than if done by contract; and not infrequently the cost is double. Men working for a city, county or state simply will not exert themselves as when working for an individual. The editor travels extensively, and wherever he on a day labor job. It is sophistical reasoning, but you can from a "contract gang" at sight. The typical "contract gang" shows far more energy than the typical "day labor gang."

It is frequently said that "day labor work" would always be as efficient as contract work if good managers were in charge, but this is not true. Whoever has been superintendent or foreman over construction forces, both day labor and contract gangs, knows that it is usually impracticable to get a day labor gang to work as vigorously as a contract gang.

"The State is rich. Don't break your back saving a few cents for the State." "Who put the governor in his soft job? Your votes and mine. Well, the governor appointed the commission; the commission appointed the engineers, and they appointed the foremen. So every last Jack of them owes his job to our votes. Why should we sweat more than the men who owe their jobs to us?" Such is the reasoning of the man that wields the shovel or runs the engine on a day labor job. It is sophistical reasoning, but you can no more convince him of his error than you can persuade a Hindoo that the system of caste is grossly uneconomic.

*From "Engineering and Contracting," Chicago.

ELECTRICITY AND CIVILIZATION

IN connection with the value of water powers, the "Electrical World," of New York, commenting on remarks by Dr. George Otis Smith, Director of the United States Geological Survey, states that, in the long run, the utilization of water power means the saving of human energy for purposes to which power-driven machinery is not yet adapted. The mere change from steam power to water power is not only significant of lower costs in manufacturing and of the saving of the earth's stored fuel for its more important uses, but it relieves the labor necessary in mining the coal and the still greater burden of transporting it.

Every water power harnessed and displacing steam power implies, therefore, a great band of laborers in the mine and on the railways freed from this particular necessity of toil, for other and more useful work. Now that the price of labor has risen beyond the wildest dreams of a few years ago, we are approaching an era when, wherever possible, human energy will be replaced by mechanical or electrical power.

If we are to attain a condition of production that will give us a chance of successful competition in the world's market, it must be through the most determined efforts at cheap power production and all possible saving in the field of human labor. The great power enterprises of the present day give opportunities such as have not yet been realized.—By Leo G. Denis, writing in "Conservation," published by the Commission of Conservation, Ottawa.

ADVISORY BOARD TO DOMINION HIGHWAYS BRANCH CONFERS WITH PROVINCIAL OFFICIALS

OFFICIALS from various provinces met the Advisory Board of the Highways Branch, Department of Railways and Canals, last week at Ottawa, and discussed how the $20,000,000 federal aid should be spent.

Copies of the form to be used in applying for aid, which had been prepared by A. W. Campbell, the head of the Highways Branch, were submitted to and approved by the provincial representatives, and other regulations were also discussed.

Those present from the various provinces were: Nova Scotia, Hon. H. H. Wickwire and Chief Engineer J. W. Roland; New Brunswick, Chief Engineer B. M. Hill; Ontario, W. A. McLean, Deputy Minister of Highways; Quebec, B. Michaud, Deputy Minister, and G. Henry, Chief Engineer; Manitoba, Alex. McGillivray, Chief of the Good Roads Branch; Saskatchewan, Hon. S. J. Latta, Minister of Roads, and his deputy, H. S. Carpenter; British Columbia, A. E. Forman, Chief Engineer, Public Works Department.

The advisory board, of which Hon. J. D. Reid, Minister of Railways and Canals, is chairman, is composed of C. A. Magrath, Ottawa; J. P. Mullarkey, Montreal; and R. Home Smith, Toronto.

RESULTS OF TESTS OF WIRE ROPE

IN "Technologic Paper No. 121," published by the U. S. Bureau of Standards, J. H. Griffith and J. G. Bragg present the results of tests on 275 wire ropes submitted by United States manufacturers to fulfill the specifications framed by the Isthmian Canal Commission in 1912. The samples were selected by government inspectors for acceptance tests of material to be used at the Canal Zone. The following review of the paper appears in "Mechanical Engineering," of New York:—

The ropes ranged in diameter from ¼ to 1½ in., a few being of larger diameters up to 3¼ in. Over half the specimens were plow and crucible cast-steel hoisting rope of 6 and 8 strands, 19 wires each. The remainder were galvanized steel guy rope and iron tiller ropes of 6 strands 7 wires, and 6 strands 42 wires, respectively.

The investigation was made primarily to determine the tensile strengths of the ropes. Much of the experimentation was of a supplementary character—to determine the general laws of construction of the rope as the basis of the interpretation of their physical behavior under stress. A comparative analysis was made of the chemical constituents of steel, rope fibers and lubricants of plow ropes submitted by different manufacturers.

The wires at the ends of specimens were "frayed out" to form a "broom." These were inserted into molds, into which molten zinc was poured so as to form conical sockets for connection to the testing machines. Most of the tensile tests were made on a 600,000-lbs. Olsen testing machine, the ropes of large diameters being tested on the 1,200,000-lbs. Emery machine. Stress-strain measurements were made on over half the specimens. Numerous tests of individual wires were conducted in tensile, bending and torsion machines. The strengths of the cables were studied in connection with their modes of construction, the strengths of their component wires and the types of fractures which were presented.

The homologous linear dimensions of the strands, wires and fiber cores were found to vary in direct proportion to the diameters of the ropes. The diameters of the strands and fiber cores were generally ⅓ the diameter of the rope. The mean pitch or lay of the strands was 7½ diameters. The mean lay of the wire was 2¾ diameters. The mean diameter of the wires was expressed by the equation:—

$$d = KD/(N+3)$$

where d = diameter of wires
D = diameter of rope

N = number of wires in outer ring of wires of a strand

K = { 1.0 for hoisting and guy rope; 0.8 for extra flexible 8 x 19 hoisting rope; 0.33 for tiller rope.

The aggregate cross-sectional areas of the wires was expressed approximately by the equation:—

$$A = CD^2$$

where C = 0.41 for 6 x 19 plow steel hoisting rope
= 0.38 for 6 x 19 crucible steel hoisting rope
= 0.38 for 6 x 7 guy rope
= 0.35 for 6 x 17 plow-steel rope
= 0.26 for 6 x42 iron tiller rope.

It was found when the maximum loads determined from tensile tests were platted as functions of the diameters of the ropes that the curves bounding the lower frontiers of each zone comprising the observed values were in close agreement with similar curves platted from the minimum strength stipulated in the specifications of the Isthmian Canal Commission of 1912. These strengths were also in approximate agreement with the standard strengths recommended in 1910 by the manufacturers from the results of their tests of cables similarly classified. The minimum strengths found from the present investigation are given by the following empirical equation:—

$$\text{Load} = C \times 75{,}000 D^2$$

where D = diameter of wire rope in inches

C = { 0.9 to 1.1 (mean about 1.0) for 6 x 19 plow-steel cables; 0.8 to 0.95 (mean, about 0.9) for 8 x 10 plow-steel and 6 x 19 crucible cast-steel cables. 0.3 to 0.4 (mean, about 0.35) for iron tiller and steel guy rope

The modulus of the rope calculated from stress-strain measurement was found to vary from 3,000,000 to 9,000,000 lbs. per sq. in., depending upon the diameter and class of cable.

Plow-steel ropes were selected for comparative analyses of the constituent materials. In the chemical analyses the carbon content ranged from 64 to 96 per cent., with a mean of about 75 per cent. The manganese ranged from 25 to 68 per cent., the silicon from 11 to 24 per cent. The percentage of phosphorus and sulphur was relatively low. In certain cases the steel of the filler wires was softer than the main wires.

The fibers used in making the core of the rope were estimated as manila, jute, istle, mauritius, manila fiber alone being employed by certain manufacturers. The preservative and lubricants on the cores were composed of wood and vegetable tars, petroleum products, and fish oil, the practice varying somewhat.

There was a reasonable uniformity in the strengths and elongations of the wires from a particular cable, but a larger variation in the strengths of the wires from cables of different manufacturers. This was probably due to the fact that different grades of plow steel were used by the several manufacturers in meeting the provisions of the specifications.

The cables developed from 72 to 90 per cent. of the aggregate strengths of the wires. The upper limit of the ratio of the strength of a rope to the strengths of its wires was found from theoretical considerations to be 89.2 per cent. for 6 x 19 plow-steel cables. The differences between the results of the theoretical analysis and the practical tests were largely attributed to different strengths and degrees of ductility of the wires, this causing an unequal distribution of the load among the strands, with over-stressing of certain strands near the point of failure.

The Civil Service Commission of Canada will receive applications not later than September 6th for the following positions at the Royal Military College, Kingston, Ont.: Professor of engineering, salary $3,480; instructor in physics, $1,800; instructor in civil engineering, $1,800. W. Foran, Ottawa, is the secretary of the commission.

TOWN PLANNING IN EASTERN CANADA*

THE Nova Scotia Town Planning Act has been amended in accordance with suggestions made by the Town Planning Branch of the Commission of Conservation. The Act formerly required that town planning schemes or by-laws had to be prepared before 1918, but the war prevented this being done. Under the amendments made the period for compulsory preparation is extended to 1921. The Act has also been widened in scope to deal with rural as with urban development. The model town planning by-laws of the province have been prepared for recommendation to the municipalities.

Nova Scotia has also passed a Housing Act to enable the province to take advantage of the federal loan. A draft housing scheme is under consideration. In the investigations made into the housing shortage in Canada and the costs of building, it has been found that conditions are worse in Halifax than in any other part of the Dominion, owing to the combined effects of exceptional prosperity and the destruction caused by the disaster of 1917.

The Halifax city and county schemes, covering large areas, are well advanced in preparation.

New Brunswick

The St. John Town Planning Scheme, dealing with over 20,000 acres, has been approved by the councils of the city and the county municipalities. This is an important achievement having regard to the novelty of many of the provisions of the scheme and the somewhat drastic changes which they introduced in local procedure. The scheme has been prepared by the City Planning Commission in consultation with the Town Planning Branch of the Commission of Conservation. The Housing Act of New Brunswick is now on the statute books and a housing scheme has been prepared by the province and approved by the federal government.

Quebec

In Quebec a Housing Act has been passed, a provincial housing scheme has been prepared and a director of housing has been appointed. The Quebec scheme conforms more strictly to the federal scheme than the schemes in any other provinces. Practically all the recommendations of the federal government have been introduced into the Quebec scheme in a mandatory form. The appointment of Dr. Nadeau as director of housing is significant of the importance which the province attaches to the promotion of housing schemes in the form of garden suburbs and with proper town planning provisions. For many years Dr. Nadeau has been an active worker for town planning and housing reform in Quebec.

Although Quebec is the only eastern province without a Town Planning Act, it has introduced town planning provisions in its housing scheme and the intention is to pass a Town Planning Act at the next session of the legislature.

Ontario

The fact that Ontario was responsible for initiating the movement for government housing in Canada and that the province has appropriated $2,000,000 of its own money to be spent in housing, has given it a start in advance of the other provinces in the matter of carrying out housing schemes. The Housing Act and scheme of the province was approved by the Federal government on February 20th last.

J. A. Ellis, an ex-mayor of Ottawa and a member of the Ontario Railway and Municipal Board, has been appointed director of housing, and is giving able leadership to the movement in the province. The director reports that 47 municipalities have already appointed housing commissions and applied for loans, and that the whole of the $10,000,000 available is already spoken for. Actual building operations have begun in Toronto. Two sites of about 40 acres in area have been acquired in the city of Ottawa and are being planned with a view to building operations being started in the immediate future.

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*From "Conservation of Life," published by the Commission of Conservation, Ottawa.

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PRESSURE RISE IN PENSTOCKS

PRESSURE rise in penstocks, due to gradual gate closure, forms an important problem in hydro-electric developments, as it not only affects the design of penstocks, but also the regulation of the plant, which is of prime importance.

The article which starts on page 269 of this issue opens a new field for the investigation of this problem in regard to its effect upon regulation. Mr. Gibson has applied to slow gate closures Prof. Joukovsky's theory of maximum water-hammer, which had been proven experimentally by Prof. Joukovsky himself in regard to instantaneous gate closures. Mr. Gibson also shows the limitation of several formulas that have been in common use, such as Allievi's, Warren's and Vensano's. The accuracy of these formulas has been a source of contention among hydraulic engineers for several years, due to the assumptions upon which these formulas were based.

The solution presented by Mr. Gibson is entirely general in its application, giving correct results for any time or condition of gate closure. The method of arithmetic integration which he first uses for the solution of the problem, is worthy of special note, as many hydraulic problems that do not lend themselves to analytical solution, can be solved by this method.

Water works engineers will also be interested in this article, as frequently the cause of serious breaks in water mains can be traced to excessive pressure rise due to the sudden shut-down of a pump. It is not likely, however, that the broad application of Mr. Gibson's paper will be universally appreciated at first glance. Indeed, one of the country's leading hydraulic engineers states that it will be fifteen years before its full use is realized to the maximum. This can be readily believed when one considers that Prof. Allievi dealt analytically with this same subject fully 12 years ago in Italy, and that his paper to this day has never been translated into English in its entirety. It may be mentioned that those who are familiar with the original text of Prof. Allievi's work, state that his results coincide with those that have been secured by Mr. Gibson by an entirely different method.

AEROPLANES IN BUSINESS LIFE

PRESENT standards of business efficiency are rapidly undergoing readjustment on account of the introduction of the aeroplane to everyday business activities.

Previously, when an engineer requested samples, he thought that the firms with whom he was dealing were very prompt and efficient if his letters were answered by return post and samples mailed at once by parcels post or express. To-day, the samples are likely to arrive by aeroplane.

A few years ago, when an engineer offered plant for sale, machinery firms sent representatives by train to inspect it, and if they arrived within several days after their presence had been requested, their firms were said to be "right on their job." The modern machinery man is likely to land at your factory door in an aeroplane within a few hours after he gets your letter or telegram.

This will certainly influence the rapidity with which business will be transacted in the future. The example set by a few enterprising firms will extend, and soon hundreds of business men will learn aviation or employ aviators in order to prevent their more venturesome rivals from stealing a march in important deals. Or should we say, stealing a flight?

One alert young business man in Toronto, A. R. Roberts, a dealer in contractors' equipment, declares that he intends to use an aeroplane for business trips to all parts of Ontario, whenever the weather is suitable and the business urgent. A fortnight ago he flew from Toronto to Owen Sound to inspect a boiler in order to be able to effect its immediate purchase for a client. He left Toronto at 2 p.m., stayed in Owen Sound for 2½ hours, and was home in time for dinner at 7 p.m. The scheduled time for trains from Toronto to Owen Sound (one way) is more than five hours. Mr. Roberts began the study of aviation only a couple months ago and purely for business purposes. If he finds it worth while to go to that trouble, are not scores of returned officers, who have had extensive experience in flying at the front, likely to find that their knowledge of aviation is a real asset in peaceful pursuits?

In the United States a large manufacturer of contractors' equipment is now using an aeroplane for advertising purposes. Lt. George M. Comey, late of the A.E.F. air service, and a Curtiss biplane are engaged in distributing free copies of the "Lakewood Aerial Bulletin," a clever house organ published by the Lakewood Engineering Co., of Cleveland. The first issue contains numerous illustrations of Lakewood equipment and also a number of witty remarks, including the following:—

"These bulletins are dropped in an attempt to reach a height equal to that of the quality of the Lakewood line.

"Circulation, highest in the world. No copies delivered by mail or newsboys.

"After decreasing the weight of his plane by dropping these bulletins, Lt. Comey was still unable to reach an elevation equal to the Lakewood standard.

"Frank A. Michell, general purchasing agent of the Lakewood Engineering Co., is accompanying Lt. Comey on this trip. Mr. Michell does not intend to place any orders on the way, but, as he says, just to find out if he can see the top of the high prices."

In the last issue of "Engineering News-Record," of New York, there appeared the following interesting editorial on aeroplane passenger traffic:—

"Speculation has naturally been rife among laymen as to the probability of the early introduction of the aeroplane into regular passenger service. Its possibilities appear to be so great that one is eager to see the predicted development

begin. For some time there has been regular passenger service between Paris and Brussels, while this week's cables tell of the inauguration of service between London and Paris. Those who have studied the situation account for the slowness of development on two grounds—the natural conservatism of capital in venturing into a new and untried field beset, apparently, by peculiar hazards, and the lack of suitable, centrally located landing fields. They do not believe that the dangers of aeroplane travel, when calmly considered, are a deterrent from the standpoint of the operating company, though the risks may tend to discourage prospective passengers. Aeroplane travel, of course, is not attended with the degree of safety of rail or even water travel, but the constant use of aeroplanes for transporting British diplomats between London and Paris, from the very beginning of the peace conference, shows the confidence of the British air service and British officials in this mode of travel. Safety measures are receiving careful study—parachute experiments, for example—and these will go far to remove the fears that the public now entertains. As to landing fields, a new civic and civil engineering problem enters here. The landing of passengers far out in the suburbs is naturally a handicap, even though automobiles are in waiting. In this respect, too, advances are to be looked for. Landing and starting in smaller areas than are now felt necessary will surely come. Incidentally, the success of the New York-Washington aeroplane mail service should not be forgotten. It gives warrant for the optimism of those who contend that there is no physical reason why a New York-Chicago passenger aeroplane service should not be in operation."

PERSONALS

CAPT. BRUCE ALDRICH, who has been appointed as the Asphalt Association's district engineer for Canada, was born in London, Eng. He was brought to Canada at an early age and received his primary education in the public schools of Ottawa, returning later to England for further study. Again leaving England, Capt. Aldrich went to the United States and served as a volunteer in the United States army in the Spanish-American and Phillipine wars. In 1901, he joined the staff of the inspector of asphalts and cements, engineer department, District of Columbia, where he served until February, 1912, in various capacities, testing paving materials under Prof. A. W. Dow, of New York City. In March, 1912, he went to Baltimore, Md., which was then undertaking the biggest paving program in the history of that city, with expenditures aggregating nearly $15,000,000. Capt. Aldrich organized and equipped the municipal laboratory, in which were tested all the materials entering into the new paving. As inspector of asphalts he supervised the laying of more than 3,000,000 sq. yds. of sheet asphalt and bituminous concrete, having at times as many as seven asphalt plants working simultaneously. He assisted also in the inspection and construction of all vitrified brick and concrete block pavements laid in Baltimore. When the United States declared war upon Germany, Capt. Aldrich volunteered in an infantry battalion and served at the front for one year with the rank of captain. He returned to the United States last June and resumed his Baltimore position, which he has now resigned in order to accept the appointment with the Asphalt Association. The head office of the Asphalt Association is at 15 Maiden Lane, New York City. With the staff at that office, Capt. Aldrich will be in close touch, but his personal headquarters will be in Toronto. On account of the present crowded condition of office space in Toronto, he will make his headquarters at the office of the H. K. McCann Co., 56 Church St., until he can find suitable offices. It is his intention to co-operate gratuitously in every way possible with municipal officials, consulting engineers and others in obtaining the best results in the construction of asphaltic pavements of all types. His work will be impartially in the interests of all asphalt producers and his services will be equally available whatever kind or brand of asphalt may be used in the construction.

C. A. LOUNT, superintendent of water works at Cornwall, Ont., has placed his resignation in the hands of the town council.

IVAN WALKER has been appointed chief engineer of the Kitchener Water Commission to succeed his father, who has resigned.

WILLIS CHIPMAN, who designed the William Head Quarantine Station's water works system, at Victoria, B.C., recently visited that city for the purpose of testing the plant.

J. I. NEWELL, electrical superintendent, British Columbia Electric Railway, Vancouver, B.C., has taken over the hydro-electric engineer's duties, succeeding F. S. Easton, who resigned to join the Mexican Light & Power Co.

MAJOR CECIL EWART, formerly of the 8th Battalion, Canadian Railway Troops, is now engaged in locating a line from the Pacific Great Eastern Railway at Clinton, B.C., to Ashcroft, B.C., for the Department of Railways of British Columbia, of which department F. C. Gamble is chief engineer.

GEO. H. BRYSON, city engineer of Brockville, Ont., intends to resign in order to become manager of the Brockville Highway Construction Co. Mr. Bryson is financially interested in this company, which has just secured a large contract for penetration bituminous road construction for the province of Ontario.

CAPT. LUCIUS A. FRITZE has become associated with the technical staff of Wallace & Tiernan Co., Inc., of New York City, manufacturers of chlorine control apparatus. Capt. Fritze, who was sanitary officer of the Rainbow Division, U.S. Army, after the armistice, was assigned to the office of the Surgeon-General in Washington, and while there prepared a history of the Sanitary Corps of the A.E.F. Capt. Fritze will be the manager of a new office which Wallace & Tiernan Co. are opening at Kansas City, Mo.

OBITUARY

THEODORE COOPER, one of the continent's leading bridge engineers, died August 24th, in New York City, at the age of 80 years. He began private practice in 1879. His name became universally familiar through his system of locomotive and train loadings for bridge design. Composed of a wheel system representing the heaviest locomotives of that time, followed by a uniform load whose amount in pounds per foot bore a simple relation to the driving-axle load, this system proved so convenient, and was so excellently adapted to modification for increasing weight of trains and engines by simple multiplication, that it quickly won a commanding position, and for many years has been the almost universal standard for railway-bridge design. Mr. Cooper was born at Cooper Plains, N.Y., and was a graduate of Rensselaer Polytechnic Institute.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand or proposed, contracts awarded, changes in staffs, etc.

ADDITIONAL TENDERS PENDING

Not Including Those Reported in This Issue

Further information may be had from the issues of *The Canadian Engineer*, to which reference is made.

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Como East, Que., roads	Sept. 8.	Aug. 28.	267
Depot Harbor, Ont., wharf	Sept. 12.	Aug. 28.	46
Kitchener, Ont., motor and pumps	Sept. 11.	Aug. 28.	48
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York Tp., Ont., water mains	Sept. 6.	Aug. 28.	50
York Tp., Ont., water mains	Sept. 6.	Aug. 21.	45
York Tp., Ont., sidewalks	Sept. 6.	Aug. 21.	48

BRIDGES, ROADS AND STREETS

Annapolis Royal, N.S.—Contract has been awarded by the board of highway commissioners, department of public works, Halifax, for concrete abutments and bridge sheets on ten existing piers to the Engineers and Contractors, St. John, N.B. J. W. Roland, chief engineer.

Aurora, Ont.—Town council will pave Yonge St. within the town limits this year.

Brockville, Ont.—Town council contemplates construction of pavement on Pine St., from Wall to Park St. Estimated cost, $12,094.

Brome, Que.—Contract has been awarded to the Phœnix Bridge Co., Montreal, for construction of steel bridge. Cost, $12,000.

Chilliwack, B.C.—City council has recommended to the public highway department, Victoria, that the tender of the Columbia Bitulithic Co., Ltd., for surfacing the Yale macadam roadway within the city limits be accepted.

Comber, Ont.—Council proposes to construct a reinforced concrete roadway and drain on Queen St. J. J. Newman, engineer, Davis block, Windsor.

Edmonton, Alta.—City council proposes construction of a cinder walk on west side of 123rd St., between 113th and 114th Ave. C. E. K. Cox, city clerk.

Fredericton, N.B.—Surveys are being prepared for the purpose of changing the location of the highway bridge over the Nerepis stream in Petersville, Queen's County. P. J. Veniot, minister of public works.

Galt, Ont.—City council proposes to construct an asphaltic concrete pavement and concrete curbs and gutter on Wellington St., from Main St. to north side of Dickson St. Estimated cost, $5,902.30. Joseph McCartney, city clerk.

Markham, Ont.—Contract has been awarded by township council for construction of three concrete bridges to R. H. H. Blackwell, Aurora. James, Loudon and Hertzberg, Toronto, engineers.

Matilda Township, Ont.—Tenders will be received until 7 p.m., September 12th, for construction of two concrete culverts, 10 ft. span, road No. 2, concessions Nos. 1 and 4. J. G. Cameron, county road superintendent, Finch.

Nanaimo, B.C.—Ratepayers of Haliburton St., will request council to construct permanent pavement.

Newmarket, Ont.—Town council contemplates constructing permanent pavements on Yonge St.

Ottawa, Ont.—Contract has been awarded by C.N. Ry. for construction of concrete culverts, bridge abutments and piers between mile 59, L'Orignal and Ottawa on the Grenville subdivision to C. L. Hervey, Williamstown, Ont. A. F. Stewart, chief engineer, Toronto.

Ottawa, Ont.—City council proposes to construct asphalt pavements on Queen St., Bay St. to Bronson Ave. Estimated cost, $10,811.46. Besserer St., Charlotte St. to east limits of lot No. 58. Estimated cost, $10,952.26. N. H. H. Lett, city clerk.

Ottawa, Ont.—The Chaudiere bridge is being moved to temporary piers to permit of construction of new steel and reinforced concrete bridge. Estimated cost of bridge, $110,000. Contractor, Dominion Bridge Co. Chief engineer, public works department, R. De B. Corriveau.

Owen Sound, Ont.—The Warren Bituminous Co. will start construction on their contract for 30,000 sq. yds. of bituminous pavement within a couple of weeks, just as soon as the portion of their plant that is now in use at Orillia is released by the completion of the Orillia contract.

Owen Sound, Ont.—Town council proposes to construct concrete curbs on 2nd Ave. East, from 6th St. to Jubilee Bridge and on 12th St. West, from 4th Ave. West to 6th Ave. West. D. H. Fleming, town engineer.

Pembroke, Ont.—Council contemplates construction of improved roadways on the following streets: Sussex St., from McKay to Commercial St.; McAllister St., from McKay to Commercial St.; Pembroge St., from Commercial to Arnold's Lane and from Hincks St. to Moffat's crossing; Isabella St., from Maiden Lane to Doran St., and the widening and production of Lake St., together with a bridge over the Muskrat River. W. J. Moore, town engineer.

Portage la Prairie, Man.—Contract has been awarded to H. E. Walker Co. for construction of 12 miles of roadway between Portage la Prairie and Winnipeg. Contract price, $25,200.

TOWNSHIP OF YORK

Sealed tenders, plainly marked as to contents will be received by the undersigned for the Municipal Corporation of the Township of York, up to 12 o'clock **Noon** of **Saturday, September 13th.** for the construction of the following works:—

Tarvia X Pavements on Glenholme Ave. and Pinewood Road.

Concrete sidewalks on Atlas Ave., Glenholme Ave., St. Clair Ave., St. Johns Road, Miller Ave., Frejama Ave. and Dennis Ave.

Plans and specifications and all necessary information may be obtained at the office of the engineer, Frank Barber, 40 Jarvis Street, Toronto.

The lowest or any tender will not necessarily be accepted.

FRANK BARBER,
Engineer.

Toronto, Sept. 2nd, 1919. 345

Prince George, B.C.—The provincial government is having surveys prepared for the construction of a permanent roadway and bridge over the Fraser River into the Mount Robson country. Construction of the bridge will start immediately. Hon. Dr. J. H. King, minister of public works. H. Taylor, bridge engineer.

Regina, Sask.—City council will submit by-law to the ratepayers, September 11th, providing for permanent paving on spur track crossings in warehouse district. Estimated cost, $14,000.

Reston, Man.—The municipality of Pipestone will construct a 25 ft. standard girder bridge over Gopher creek, east of section 36-9-27. G. F. Birney, secretary-treasurer, Reston, Man.

South Mountain, Ont.—Tenders will be received until 7 p.m., September 12th, for construction of one-half mile of macadam on road No. 1. Yardage of crushed stone, 2,000. J. G. Cameron, county road superintendent, Finch.

St. Adelaide de Pabos, Que.—Contract has been awarded by the department of public works, Quebec, for construction of a steel bridge to the Mackinnon Steel Co., Ltd., Sherbrooke, Que.

St. Hyacinthe, Que.—Contract has been awarded by the department of public works, Quebec, for construction of bridge to J. Herbert. Contract price, $20,000.

St. John, N.B.—The department of works is preparing to pave Union, Germain and Brussels Streets. G. N. Hatfield, city engineer.

Toronto, Ont.—Contracts have been awarded by the highway department of the department of public works, Ontario, for construction of provincial highway as follows: Section No. 1, easterly limit of city of London to westerly limit of town of Ingersoll, 15.93 mls., to Frid Construction Co., Toronto; section No. 2, easterly limit city of Brantford to village of Ancaster, 15.62 mls., to D. O. Johnston, Brantford; section No. 3, from easterly limit of the village of Beamsville easterly 3.25 mls., no tender; section No. 4, easterly limit, town of Trenton, to westerly limit, city of Belleville, 9.13 mls., not yet awarded; section No. 5, westerly limit, city of Kingston, to westerly limit, township of Kingston, 7.72 mls., J. G. Murphy, 28 Dominion St., Toronto; section No. 6, easterly limit, city of Brockville, to westerly limit town of Prescott, 10.46 mls., to Brockville Construction Co. W. A. McLean, deputy minister.

Toronto, Ont.—The Toronto Harbor Commissioners will start construction of boulevard, from the Humber river, 8,000 lin. ft. easterly. This work will be done for the city of Toronto and constitutes part of the 12 mls. of boulevards designed for the water front.

Victoria, B.C.—The department of public works will soon commence construction of pavement on Lulu Island, road No. 3, and the Revelstoke west road.

Victoria, B.C.—The abutments are being constructed, and the new steel bridge over Deep creek, 20 mls. s. of Williams lake, on the P.G.E. Ry., will shortly be erected. Contractor, Northern Construction Co.

Windsor, Ont.—Council proposes to pave London St., from Ouellette Ave. to Windsor Ave. Estimated cost, $19,-190. M. E. Brian, city engineer.

WATER, SEWAGE AND REFUSE

Andover, N.B.—Contract has been awarded by the council for construction of concrete arch culvert and roadway embankment to J. E. Armstrong, Perth. Contract price, $2,800.

Aurora, Ont.—Town council will construct sewers on Yonge St., preparatory to constructing pavements.

Carleton Place, Ont.—Town council has been requested by the public utility commission to provide $11,600 for water-main and sewerage construction. W. Baird, chairman of commission.

Chatham, Ont.—City council will construct sewers on Forest St., Bedford St. to Van Allen Ave., and on Bedford St., Forest St. northerly.

Cobourg, Ont.—Town council has decided to construct drains on King St. W., from McIntosh's corner to the factory creek. Estimated cost, $2,000. Reeve Semple.

Edmonton, Alta.—City council will construct sewers along the following lanes: West of 80th St., from 122nd Ave. to Advie Ave.; west of 81st St., from 122nd Ave. to Advie Ave.; west of 90th St., from 120th Ave. to 122nd Ave.; west of 127th St., from C.N. Ry. to 108th Ave.; west of 127th St., from 109A Ave. to 114th Ave.; west of 129th St., from 111th Ave. to 112th Ave. C. E. K. Cox, city clerk.

Ford City, Ont.—Town council will construct vitrified pipe sewers on Pellette Rd., from Ottawa St. to the G.T. Ry., on Lawrence St., from Ottawa St. to the s. side of lots No. 80 and 160, on Dawson Rd., from Ottawa St. to the s. side of lots 196 and 273, and on Ottawa St., from Dawson Rd. to Pellette Rd.

Galt, Ont.—City council proposes to construct the following sewers and storm drains: Borden St., First Ave. to Stanley St.; Stanley St., Borden St. to Tait St.; and on Tait St., Stanley St. to Francis St. Estimated cost, $3,006.89. Simcoe St., King St. to bend in Simcoe St. Estimated cost, $375. Joseph McCartney, city clerk.

Newmarket, Ont.—Contract has been awarded by the town council to McNamara Co., Sault Ste. Marie, for construction of sewers on Eagle St., Water St. and Main St. P. J. Anderson, clerk.

Owen Sound, Ont.—Contract has been awarded to John Cross by town council for construction of sewers on 10th St. W. at $1.25 per ft. and on 2nd Ave. W. at $1.35 per ft. D. H. Fleming, engineer.

Pembroke, Ont.—Town council contemplates construction of six-inch water mains on McAllister St., from McKay to Commercial St., cost $1,320; and on Isabella St., from Maiden Lane to Doran St., cost $4,510. W. J. Moore, town engineer.

Pembroke, Ont.—Plans have been prepared for construction of drains on Government Rd., Christie St., Forced Rd. and Bell St. Plans will also be prepared for construction of storm sewers on Somerset, Cecelia and Fraser St. W. J. Moore, engineer.

Port Arthur, Ont.—Board of works recommended to council construction of sewer and water connections on Shortiss St.

Regina, Sask.—City council will submit by-law to ratepayers on September 11th, providing for sewer and water connections. Estimated cost, $7,000.

Sandwich, Ont.—Town council will construct vitrified crock sewers on Indian Rd., London to Peter St., and on Peter St., Indian Rd. west to Pajot Lane. E. R. North, clerk.

St. Thomas, Ont.—C. W. Tarr, of the firm of Morris and Knowles, Ltd., Windsor, is making preliminary surveys to locate suitable place for waterworks storage dam.

Welland, Ont.—City council will construct sewers on River Rd., Gadsby Ave., Margaret St. and Cohoe St. C. L. Coulson, city engineer.

Windsor, Ont.—The ratepayers of Windsor will vote on the scheme for joint water system for seven border municipalities, next January.

Winnipeg, Man.—City engineer estimates that asphalt paving on Logan Ave, from East St. to McPhillips, will cost $128,948. Construction will probably commence next spring. W. P. Brereton, city engineer.

Winnipeg, Man.—Contract has been awarded by the department of public works, Winnipeg, for excavating 300,-000 cu. yds. material in drainage district No. 2 to Carter, Halls and Aldinger, Winnipeg. Contract price, 22.5 cents per cu. yd. G. A. Grierson, minister.

Winnipeg, Man.—Estimates are being prepared for the board of the Greater Winnipeg Water District for under-

20-Year Barrett Specification Roof on Foundry Bldg. of Thos. Davidson Mfg. Co., Ltd., Montreal, Can. Arch.: A. W. Robinson, Montreal; Gen. Con.: A. F. Byers & Co., Montreal; Roofers: Hickey & Aubut, Montreal.

A 20-Year Guaranty Roof protects this Canadian Foundry—

A foundry roof has more than weather to withstand. It must be able to resist the intense heat of the furnaces underneath, and showers of red-hot sparks from above.

When the roof on the foundry building shown above was completed we gave the owners a Surety Bond *guaranteeing* their roof to be free from maintenance expense for *20-years.*

In this case the Surety Bond was hardly necessary, for the Thos. Davidson Mfg. Company, Ltd. knew from experience what service to expect, as the following paragraph from their letter to us shows:

"You will no doubt be interested to know we have insisted on Barrett Specification Roofs on all our plants, as our experience has proved it to be in every way satisfactory."

Not only are Barrett Specification Roofs "in every way satisfactory," but they cost less per-year-of-service than any other type of permanent roof, and they take the base rate of fire insurance.

20-Year Guaranty

So sure are we of the service Barrett Specification Roofs will give *under the most severe conditions,* that we are prepared to *guarantee them for 20 years,* in all towns of 25,000 or over, and in smaller places where our Inspection Service is available provided they are 50 squares or more in area. The guaranty costs you nothing. We merely require that our Specification dated May 1, 1916, shall be strictly followed and that we have an opportunity to send inspectors to watch the job during construction. The guaranty is a Surety Bond issued by a well-known fidelity and guaranty company.

Copies of The Barrett Specification, with roofing diagrams, mailed free on requesst

The Barrett Company LIMITED

MONTREAL TORONTO WINNIPEG VANCOUVER
ST. JOHN, N.B. HALIFAX, N.S. SYDNEY, N.S.

drainage of portions of the aqueduct line from Winnipeg through St. Boniface to six miles beyond Deacon. W. G. Chase, chief engineer.

Winnipeg, Man.—The city council will construct the following water mains: Dominion St., from Notre Dame Ave. to s. line, lot No. 25; Minto St., from s. line, lot No. 40, block No. 3; Dundas St., from Sargent Ave. to 449 ft. s. of Alberta St. C. J. Brown, city clerk.

York Township, Ont.—Tenders will be received until 12 o'clock noon, September 13th, by the municipal council, for construction of 6 in. cast-iron water mains in the following streets: Pinewood Rd., Atlas Ave., about 2,030 ft.; Morningside Ave., Kingsway, Garboyd Pl., Garboyd Ave., Riverside Dr., Mossom Rd., about 5,500 ft. Engineer, Frank Barber, 40 Jarvis St.

York Township, Ont.—Township engineer has surveyed and is preparing plans for a drainage system for the eastern section of the township. It is proposed to construct sewers which will discharge from a purification plant into the Don River. Five sites have been examined. The one which has been recommended by the engineer is land west of Don River in line with Westwood Ave. and adjoining the Don Valley Brick Works. Area, 11.38 acres. R. O. Wynne-Roberts, 40 Jarvis St., Toronto.

LIGHT, HEAT AND POWER

Carleton Place, Ont.—The public utilities commission contemplate the purchase of the Burgess electric system, repairs and enlargements. Wm. Baird, chairman. Estimated cost, $12,000.

Goderich, Ont.—The Lake Huron Steel Corporation plan to use 22,000 horse-power when fully operating; 15,000 horse-power will be used by next year.

Lethbridge, Alta.—The Federal Mines are considering construction of a power line to their plant across the river from the city power house.

Regina, Sask.—City council will submit by-law to the ratepayers on September 11th, providing for extension of light and power distribution systems. Estimated cost, $40,000.

Stratford, Ont.—The new Hydro-Electric Power distributing plant and the city waterworks were formally opened last Friday.

Swift Current, Sask.—A new auxiliary gas-producing power unit is being installed in the power house.

Winnipeg, Man.—The department of Indian Affairs will install an electric lighting plant in the Fort Alexander Indian boarding school. J. R. Bunn, inspector, Chambers of Commerce, Winnipeg.

RAILWAYS

Bridgeburg, Ont.—Hydro-Electric engineers have commenced surveying right-of-way for hydro-radial line, from Port Colborne to Bridgeburg.

Glace Bay, N.S.—It is understood that a railway will be constructed from Port aux Basques to Curling, Nfld., distance, 130 miles.

Scarboro, Ont.—The amalgamated ratepayers will meet September 5th to discuss construction of hydro-radials. R. Tucker, president.

St. George, Ont.—A deputation from St. George will request the Hydro-Electric Power Commission to construct the proposed Hamilton-Galt radial through the village. D. Jackson, St. George.

Swift Current, Sask.—The C.P. Ry. has commenced construction of a branch line, from Wymark to Archive, Sask.

Welland, Ont.—The N.W. and L. E. Street Ry. Co., contemplates construction of extensions into the north ward. A. J. J. Brennan, mayor. Harry Schofield, president, N.W. and L.E. Ry.

FACTORIES AND LARGE BUILDINGS

Ashburnham, Ont.—Town council will prepare plans for a fire hall to be located in east city. Mayor Duncan.

Brantford, Ont.—Robbins and Meyers Co., Springfield, Ohio, will erect a new factory for small motors and electric fans.

Brantford, Ont.—The Brantford Computing Scale Co. has received a permit for construction of additions to plant. Estimated cost, $11,000.

Brantford, Ont.—Contract has been awarded to Secord and Sons' Construction Co., Ltd., by the Slingsby Co. for construction of additional buildings to their plant. Estimated cost, $200,000.

Calgary, Alta.—A new Allen theatre will probably be constructed on Eighth Ave. Estimated cost, $200,000.

Calgary, Alta.—Contract has been awarded by the Western Canada College for construction of new building to Bennett and White Co. Contract price, $5,500.

Calgary, Alta.—The Studebaker Co. has plans prepared for duplicating its plant in South Bend. It is understood that construction will proceed as soon as housing accommodations have been secured. Estimated cost of extensions, $8,000,000. The erection of 4,000 homes for an additional 12,000 employees is contemplated. Estimated cost, $9,000,000. A. R. Erskine, president.

Capreol, Ont.—The C.N. Ry. will construct a railroad Y.M.C.A. immediately. Estimated cost, $75,000.

Capreol, Ont.—Town council will submit by-law to the ratepayers, September 20th, providing for construction of fire hall and purchase of fire engine, apparatus and appurtenances for fire protection. W. H. Mathews, clerk. Estimated cost, $8,000.

Capreol, Ont.—Construction work to be undertaken this summer includes the following: Northern Investment Co., 14 houses, cost $42,000; C.N. Ry., 16 houses, cost $48,000; Rossman's theatre, cost $20,000; R.C. church, cost $40,000; and a Masonic temple, cost $22,000.

Dalroy, Alta.—Tenders will be received until noon, September 6th, by board of trustees, Turner school district No. 3,797, for construction of frame school building. F. W. Fraser, secretary-treasurer.

Drummer Township, Ont.—Council contemplates constructing an addition to the town hall as a soldiers' memorial. R. Deen, clerk.

Edenwold, Sask.—Contract has been awarded by school board to Waterman and Waterbury Co., Regina, for construction of school. Contract price, $10,000.

Edmonton, Alta.—R. A. Barrow has awarded contract for construction of garage on 103rd St. to Frost and Ingram. Estimated cost, $11,500.

Essex, Ont.—Dr. Doyle has awarded contract to W. N. McEachren and Sons, Ltd., Toronto, for construction of ten modern houses on Talbot St.

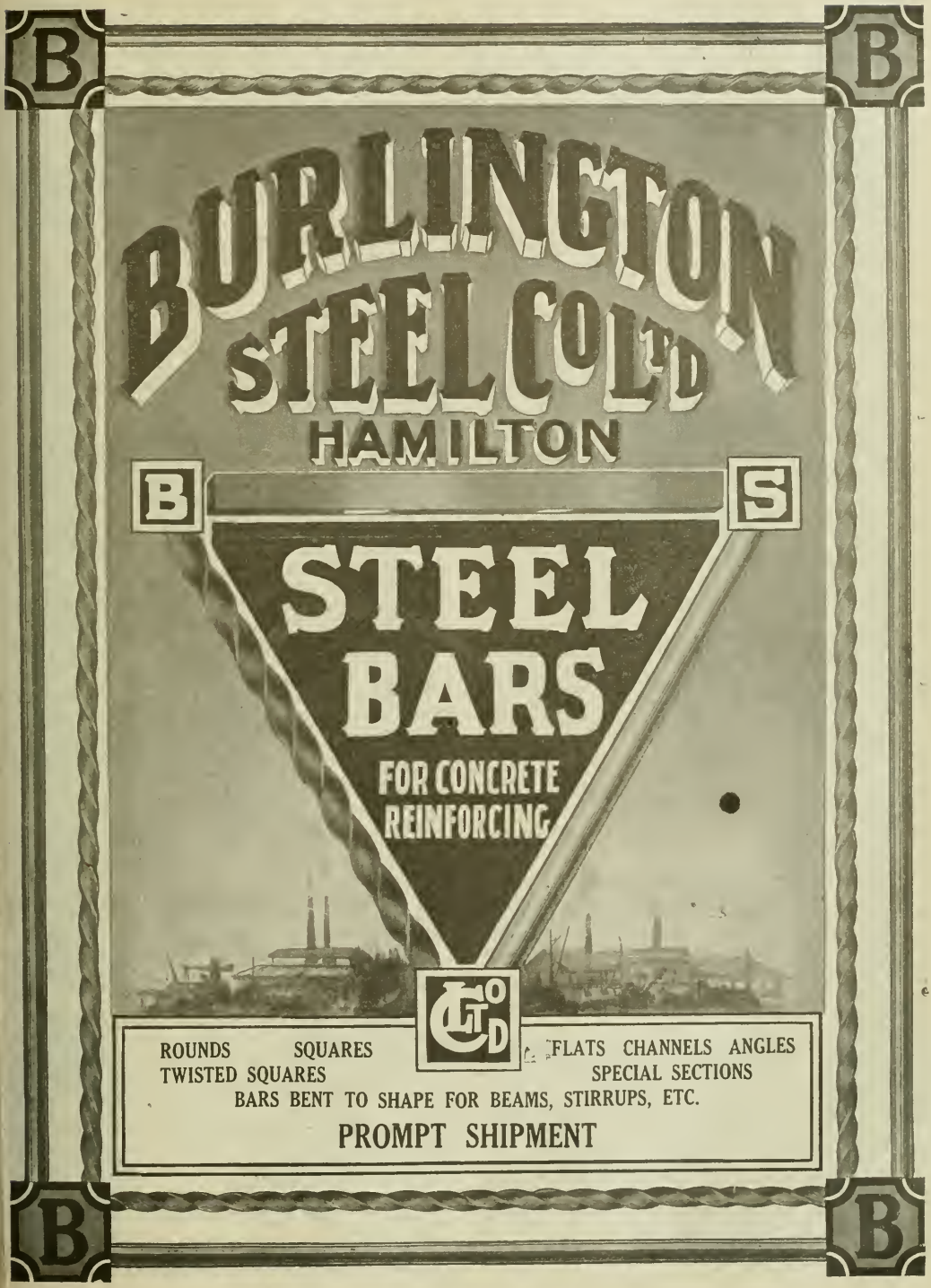
Ford, Ont.—Tenders will be received by the board of education until 5 p.m., September 5th, for construction of a school building on Drouillard Rd. J. C. Pennington, architect.

Fort William, Ont.—F. H. Keefer may convert the convalescent home, which is closing, into an apartment house by the addition of two more stories. Estimated cost, $150,000.

Fredericton, N.B.—The proposed Fraser memorial hospital buildings, planned in connection with the present Victoria public hospital, will be built in the near future. Tenders recently called were considered too high and new tenders will probably be called for immediately. Archibald Fraser.

Goderich, Ont.—The Lake Huron Steel Corporation has secured a 250-acre site along the water front, and will construct a large steel plant. Estimated total cost, $8,000,000. E. R. Wigle, mayor.

Hamilton, Ont.—By-laws will be prepared to provide for construction of Hunter St. school, $120,000, alterations to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TWISTED SQUARES SPECIAL SECTIONS
BARS BENT TO SHAPE FOR BEAMS, STIRRUPS, ETC.
PROMPT SHIPMENT

Central school, $33,000, installation of a household science department, new memorial school, $35,000.

Indian Head, Sask.—Contract has been awarded by the department of public works, Ottawa, for construction of a brick office building for the forestry branch of the experimental farm, to Wilson and Wilson, Regina. Contract price, $30,000. R. C. Desrochers, secretary.

Ingersoll, Ont.—Council has been requested by the board of education to prepare and submit to the ratepayers a by-law authorizing construction of a new school. Estimated cost, $120,000.

Kitchener, Ont.—The water commissioners will construct and equip a new pump house over the well on Strange St. Capacity of well, 500,000 gallons per day. Superintendent Hymmen.

Kitchener, Ont.—A committee has been formed to obtain funds for construction of a Y.M.C.A. building. F. J. McKellar, secretary.

Leaside, Ont.—Tenders will be received until 6 p.m., September 10th, by the architect, for construction of houses. Plans, etc., at office of Canada Wire and Cable Co., Leaside. Architect, W. L. Somerville, Imperial Bank building, Yonge and Bloor St., Toronto.

London, Ont.—City council contemplates addition to buildings and extensions to fair grounds. A. M. Hunt, secretary, Western Fair Board, London.

London, Ont.—Loew's London Theatre Co. have received permit for construction of new building on Dundas St. Estimated cost, $210,000. Architect, T. W. Lamb, New York. Contractor, P. H. Secord and Sons, Hamilton.

Maidstone, Sask.—Contract has been awarded by the school board for construction of school to Waterman and Waterbury Co., Regina. Contract price, $12,500.

Markinch, Sask.—The school board will erect a new building. Storey and Van Egmond, architects. W. L. Leggett, secretary.

Melfort, Sask.—Tenders will be received until September 5th, by the board of the Melfort public school district No. 1,037, for construction of a four-roomed, brick, steam-heated bungalow school, with full basement. Architect, J. Melrose Morrison, 325 Drinkle block No. 1, Saskatoon.

Montreal, Que.—A committee has been formed in connection with the proposed construction of St. Mary's memorial hospital. M. J. Fennell, Jr.

Montreal, Que.—L. A. Dubrule has purchased the Dow property on Phillip Place and will build a moving picture theatre. Estimated cost, $200,000.

Montreal, Que.—The board of directors of the National Breweries have decided to enlarge their buildings. Estimated expenditure, $500,000.

Moose Jaw, Sask.—The MacLean Grocery and Lloyd's Fruit Co., Ltd., will erect a warehouse at corner of Seventh Ave. and Osler St., immediately. R. C. Bunyard, architect.

Moose Jaw, Sask.—The city council will construct a public comfort station on block No. 93, old No. 96. George D. Mackie, city commissioner.

Mullin's Brook, N.B.—A plant to manufacture hardwood lasts and furniture will be constructed. H. Mobbs, Kettering, England.

Nacmine, Alta.—Contract has been awarded by the school board district No. 3,771, for construction of school to A. P. Johnston, Drumheller. Contract price, $7,790. Rejected tenders, Allison and Gray, Calgary, $7,800; J. B. Parsons, Drumheller, $7,893; A. Buvyer, Drumheller, $8,153. C. Campbell, secretary-treasurer.

Oak Bay, B.C.—A by-law will be submitted to the ratepayers providing for construction of an eight-roomed school. Estimated cost, $94,000, of which the provincial government will grant $30,000.

Oak Ridges, Ont.—The ratepayers' association contemplates construction of a new high school building.

Oshawa, Ont.—The Pedlar People will construct modern factory buildings on Simcoe St. S.

Ottawa, Ont.—Construction of the new government building, Hunter block, Queen St., is rapidly nearing completion. Cost, $1,000,000.

Petitcodiac, N.B.—The Bank of Nova Scotia will construct a new bank building on the site of the old Mansard House.

Port Stanley, Ont.—The L. and P.S. Ry. Commission proposes to erect an amusement and recreation building on the beach, south of the incline railway. Architect Blackwell.

Prince Rupert, B.C.—Council proposes construction of a brick and stone school building on the Acropolis site. Estimated cost, $150,000. Mayor McClymont.

Regina, Sask.—Contract has been awarded by the Saskatchewan Co-operative Creameries Co. for construction of foundations for new brick and reinforced concrete creamery to Poole Construction Co. W. A. Wilson, manager.

Regina, Sask.—The Goodyear Tire Co. have awarded contract to the McKay Construction Co. for erection of a three-story brick and reinforced concrete office and warehouse on Broad and Sixth Ave. Estimated cost, $75,000. W. A. Pope, manager.

Saskatoon, Sask.—Contract has been awarded by the public school board for construction of Mayfair school to A. W. Cassidy and Co., Saskatoon.

Saskatoon, Sask.—By-law will be submitted to the ratepayers, September 4th, providing for construction of school building. Estimated cost, $175,000. R. Blackwood, architect.

Sillery, Que.—A pulp and paper mill may be established at Sillery, by American capital.

Stratford, Ont.—The park board contemplates construction of a pavilion in Queen's Park. City engineer, A. B. Manson.

Toronto, Ont.—The Hydro-Electric Power Commission of Ontario is drilling test holes to locate suitable foundations for additions to the present building on University Ave.

Vancouver, B.C.—A combined public hall and apartment house will be erected on Granville St., near Eighth Ave. Estimated cost, $15,000. T. Edwards.

Vancouver, B.C.—N. Lang has received a permit to construct a factory on Industrial Island for manufacture of electrical fixtures. Estimated cost, $3,000.

Victoria, B.C.—J. R. Thomas contemplates construction of a modern theatre for development of amateur talent. Estimated cost, $200,000.

Windsor, Ont.—A departmental store is being erected on Wyandotte St. for Paul Gilbert. Estimated cost, $30,000.

Windsor, Ont.—A new theatre and seven-story office building will be erected by the J. J. Allen, Toronto, on Ouellette Ave.

Windsor, Ont.—H. Lukos, 13 Pitt St. east, has purchased building from Dr. J. A. Menard, and will construct two additional stories.

Windsor, Ont.—By-laws granting concessions to different companies will be voted upon September 20th. The Fisher Body Co. will erect a plant costing $150,000 if the by-law is carried.

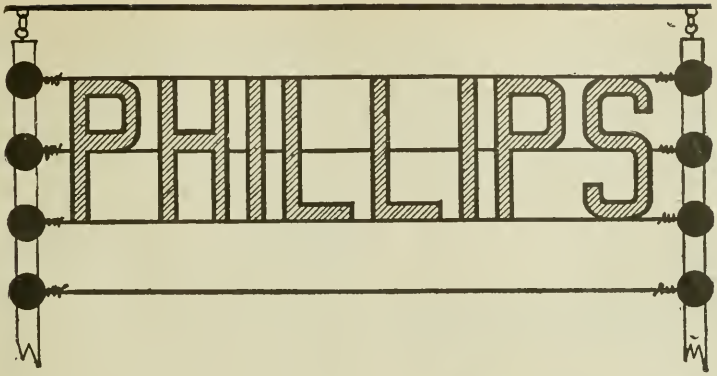
Winnipeg, Man.—The Reliance Ink Co. have decided to construct an addition to their warehouse on McGee St. Estimated cost, $8,000.

Winnipeg, Man.—The city council contemplates construction of a municipal dairy. Estimated cost, $600,000. Charles Gray, mayor.

Winnipeg, Man.—A motion picture theatre will be constructed on the site of the Fort Garry market, between Paris building and Ellice Ave. Theatre to be completed this fall. Estimated cost, $150,000.

Winnipeg, Man.—C. H. Crane and Co. will erect a new theatre on Donald St. for the Allen syndicate. Estimated cost, $205,000.

Winnipeg, Man.—Contracts have been awarded by city council for erection of show room building for city light and



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Weatherproof Magnet and Rubber Covered Wires and Cables.

Incandescent and Flexible Cords.

Telephone, Telegraph, Lighting, Power and Street Railway Wires, Cables and Equipment.

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power department on Princess St. Dominion Bridge Co., steel work; Canada Sheet Metal and Roofing Co., Winnipeg, roofing. C. J. Brown, city clerk.

York Township, Ont.—Tenders will be received until 12 o'clock noon, September 13th, by the municipal council for construction of a brick meter house on Weston Rd. Engineer, Frank Barber, 40 Jarvis St., Toronto.

York Township, Ont.—A by-law has been passed by the municipal council providing for construction of eight additional rooms to Secord Ave. school. Estimated cost, $60,000. W. A. Clarke, clerk.

MISCELLANEOUS

Berthier, Que.—Contract has been awarded by the department of public works, Ottawa, for repairs to wharf to Mozaire Le Saurneau, Montmagny. Contract price, $18,500. R. C. Desrochers, secretary.

Calgary, Alta.—The board of trade has adopted a resolution requesting the Dominion government to make such an appropriation, at the coming session of parliament, as will be sufficient to determine the location of canals, reservoir capacity, additonal acreage to become available under irrigation, acreage which can be watered for stock, etc. Areas referred to, lie between the North and South Saskatchewan, the Battle and Red Deer rivers.

Cobourg, Ont.—Town council has decided to purchase a Chevrolet fire truck fitted with two chemical tanks and 200 ft. of hose. Estimated cost, $2,650. Reeve Semple.

Coleville, Sask.—The Rural Telephone Co. will construct additions to its present system. George Manning, secretary.

Dundas, Ont.—Contract has been awarded by the Canada Crushed Stone Corp. for construction of storage bins, steel towers, etc., to F. F. Fry, Toronto.

Edmonton, Alta.—City council will receive a report from the superintendent of the streets department for construction of a new incinerator which will be so arranged as to provide steam heat to the Royal Alexandra hospital. D. Alton, superintendent.

Hamilton, Ont.—Tenders will be received until 12 o'clock noon, September 11th, by the Parks board, city hall, for reconstruction of wharf at Wabasso Park, Hamilton. Specifications and forms of tender may be obtained at office of E. R. Gray, city engineer. A. J. Wright, chairman of Parks board.

Hamilton, Ont.—The Dominion Steel Foundry Co. will open an agency for shipbuilding and railway supplies. C. W. Sherman, president.

London, Ont.—City engineer is preparing a report to council recommending purchase of several tractors to work on construction programmes. H. A. Brazier, city engineer.

Montreal, Que.—Tenders will be received until 12 o'clock noon, September 16th, by the Harbor Commissioners, Montreal, for cribwork construction timber, ship-building timber, British Columbia timber and railway ties. F. W. Cowie, chief engineer. M. P. Fennell, secretary.

North Battleford, Sask.—Tenders will be received until 1 p.m., September 8th, by the department of telephones, for the erection of a fire-proof exchange building. Plans, etc., at office of architects, Storey & Van Egmond, Regina, and at telephone exchange, North Battleford. D. C. McNab, deputy minister, department of telephones, Regina.

Oshawa, Ont.—The ratepayers have carried a by-law to purchase the present factory site of the Pedlar People for park purposes. Purchase price, $50,000.

Petit Rocher, N.B.—New tenders are being called by the department of public works, Ottawa, until 12 o'clock noon, September 16th, for repairs to breakwater at Petit Rocher. Plans, etc., office of district engineer, Chatham, N.B., and post office, Petit Rocher, N.B. R. C. Desrochers, secretary.

Port Elgin, Ont.—Contract has been awarded by the department of public works, Ottawa, to M. Clairmont, Goderich, for repairs to wharf and partial reconstruction of breakwater. R. C. Desrochers, secretary.

Quaco, N.B.—Tenders will be received until 12 o'clock noon, September 17th, by the department of public works, Ottawa, for reconstruction of eastern breakwater, Quaco (St. Martins), County of St. John, N.B. Plans, etc., offices of district engineers at St. John, N.B.; Halifax, N.S., and at post office, St. Martins, N.B. R. C. Desrochers, secretary.

Regina, Sask.—The city council will purchase tools and equipment, including three soot-blowers and an 18-ft. lathe for the city power house. Estimated cost, $12,691. Superintendent Bull.

Smith's Falls, Ont.—Town engineer is preparing plans and estimates for dredging to a navigable depth that part of the Rideau canal lying between Foster's locks and Nichols' lock and providing docking facilities on the south side. J. H. Moore, engineer.

St. John, N.B.—The following tenders were received for construction of concrete retaining wall and 3-in. tile drain on St. James St. W.: E. A. Farren, wall, $18.70 per cu. ft., drain, 30c. per lin. ft.; Louis Stevens, wall, $16.80, drain, 25c.; George and Simon, wall, $15.90, drain, 30c.; J. H. Burley, wall, $15.70, drain, 8c.; Moses, Tobias and Ferris, wall, $14.79, drain, 15c.; J. Flood and Son, wall, $14.40, drain, 15c.; R. D. Innes, wall, $14.20, drain, 10c.; H. O. Clarke, wall, $13.75, drain, 10c.; Ring and Irons, wall, $12.50, drain, 10c.

St. John, N.B.—Tenders will soon be called for extension of the grain conveyor system to berths No. 14 and 15.

Thorold, Ont.—Tenders will be received until 12 o'clock noon, September 8th, by the department of railways and canals, Ottawa, for placing stone protection on summit level of the Welland Canal, between Thorold and Port Colborne. Plans, etc., at offices of chief engineer, Ottawa, and superintending engineer, St. Catharines. J. W. Pugsley, secretary.

Vancouver, B.C.—An additional dredging scheme, which includes the reclamation of a 60-acre island in the North Arm of the Fraser river, is being considered by the municipalities. This island, if constructed, would be available for industrial sites.

Tenders Called For

MELFORT, SASK.

Electrical Apparatus and Poles, Wire and Line Material

Sealed Tenders, registered and endorsed on the envelope. Tender for (tender bidden on) and addressed to A. H. Williams, Secretary-Treasurer of the Town of Melfort will be received up to September 16th, 1919, for the supply and delivery of the following equipment and materials:—

Tender "A"—For the supply, delivery and erection of switchboard and other apparatus.

Tender "B"—For the supply and delivery of weather-proof wire and line material.

Marked cheque for five per cent. (5%) of the amount of the tender must accompany each bid. The lowest, or any tender, not necessarily accepted.

Plans and specifications may be seen at the offices of the Consulting Engineers, Saskatoon, Sask.; the Secretary-Treasurer's office, Melfort, Sask.; *The Canadian Engineer*, Toronto; and *The Canadian Engineer*, Western Office, 1206 McArthur Building, Winnipeg.

A. H. WILLIAMS,
Secretary-Treasurer,
Melfort, Sask.

MURPHY & UNDERWOOD,
Consulting Engineers,
Saskatoon, Sask.

343

The Canadian Engineer

A Weekly Paper for Civil Engineers and Contractors

Reconstruction of Water Works at Cobourg, Ont.

Four Electrically-Driven Pumping Units, Each 750 G.P.M. Capacity, on Domestic Service—Gasoline-Engine-Driven Unit Replaces Steam as Standby—Three Mechanical Filter Tanks Operating Under Normal Conditions at Double Rated Capacity

By A. E. DAVISON
Municipal Engineer, Hydro-Electric Power Commission of Ontario

COBOURG, Ont., a town of about 5,000 inhabitants, obtains its water direct from Lake Ontario. The pumping station was originally an electric power plant, to which was added a belt-driven turbine pump for supply of water to the town, with two steam pumps, of the compound duplex type, for fire service.

The system was bought by the Seymour interests when the Trent river was developed. The electrical section of the plant was then disposed of and a layout made of a motor-driven pumping plant and pressure filter system, located in the old building.

The water entered the suction well through a 12-in. intake laid upon the rock bottom of the lake and anchored thereto, and a 14-in. suction pipe with foot valve supplied the pumps from the well. In addition to this, an auxiliary supply was available from six drilled wells adjacent to the station. This water was highly mineralized, a smell of sulphur being distinctly noticeable, and on account of its corrosive quality this source of supply was only used for

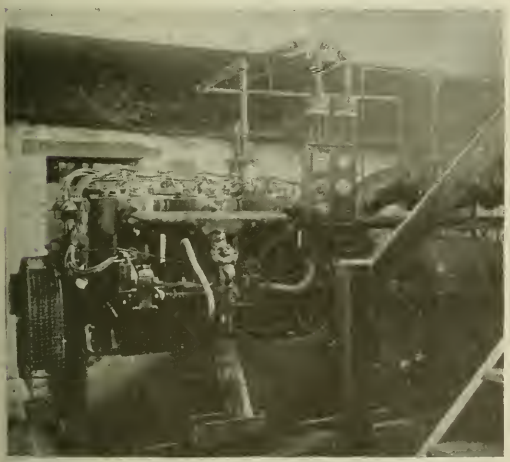

FIG. 1—GASOLINE-ENGINE-DRIVEN FIRE PUMPS

emergency and for clearing the intake of trash and ice which gave trouble in the winter season.

Four pumping units were installed, each of 750 g.p.m. capacity, arranged to operate in parallel for domestic service and in pairs in series for fire service, giving domestic capacity of 1,500 g.p.m. with reserve domestic capacity of the same amount. Pressure for domestic service is from 70 to 75 lbs., and for fire 100 lbs. at the pump-house, excess pressure under fire combination with small demand being taken care of by relief valves.

The filter plant consisted of three horizontal units 8 ft. diameter by 20 ft. long, of extra heavy construction, and with the usual connections for simple back wash. The control end of the filters is shown in Fig. 2. The rating of

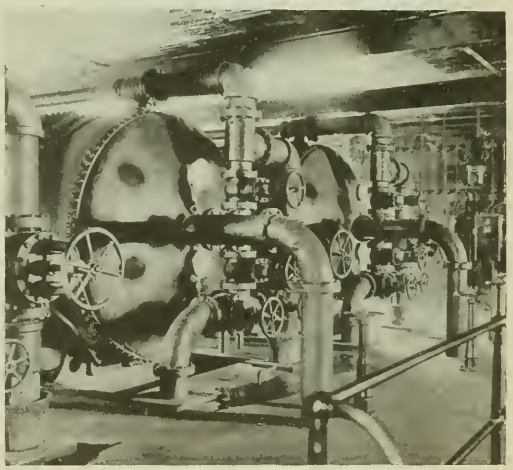

FIG. 2—MECHANICAL FILTER TANKS

each filter is 270 Imp. g.p.m. at 1.67 g.p.m. per sq. ft., which is satisfactory for muddy and contaminated water, but under present conditions, with supply taken off a clean rock bottom over 20 ft. below the surface, the quality of water is so good that the above rate can easily be increased 100%, giving a capacity of 1,600 g.p.m. under normal operation, with further increase during fire demand.

Soon after this installation was made, the town standpipe was wrecked by a fall of ice, and the system has been operated to the present time as a direct pumping proposition, without reservoir.

The location of the station is at a point on the lake shore which receives full force of all storms and there is much ice accumulation in the winter, resulting in excessive turbidity of the water near the shore and the breaking away of section of the intake pipe from time to time, so that when the system was acquired by the Hydro-Electric Power Commission of Ontario, a new intake was necessary to ensure against failure of the water supply and to relieve the

filtration plant of excessive load and constant back washing at certain seasons of the year.

A new intake was completed in 1916, of riveted steel pipe, 25½ ins. diameter, 900 ft. long, laid in a channel blasted in the rock bottom of the lake and back-filled with rock, the pipe ending in a steel intake box of ample dimensions, securely anchored in about 20 ft. of water. A new suction well was blasted in the rock 10 ft. by 30 ft. by 15 ft. deep, and covered by a brick annex to the old building. The suction main was extended to this well and the old well left for the supply of the steam reserve. The cost of the intake and suction well was about $38,000. This was higher than originally estimated, due to the impossibility of maintaining drill boats, dredges and tugs at work in the lake except in unusually fine weather.

At this time an automatic device was installed for coagulant and hypochlorite in place of the usual hand-controlled feed apparatus.

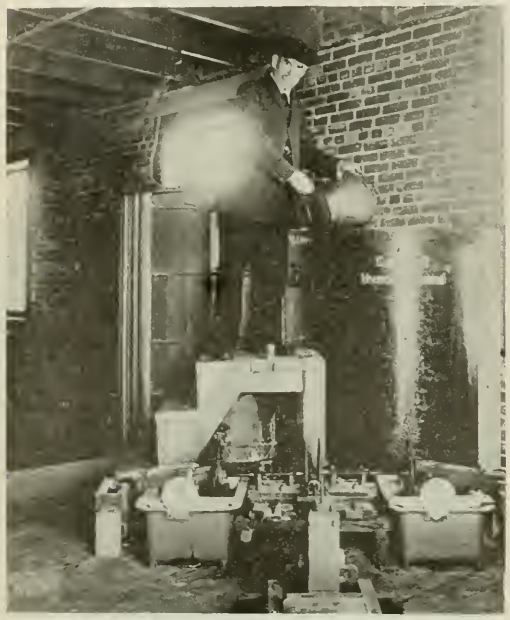

FIG. 3—AUTOMATIC DEVICE DESIGNED BY THE "HYDRO" MUNICIPAL ENGINEERING STAFF FOR FEEDING COAGULANT AND HYPOCHLORITE

The new device is mechanically driven by a turbine placed in the mouth of the intake pipe within the suction well, of sufficient size to operate the device under velocity head only, and with as low a discharge as 300 g.p.m.

The power required being extremely small, the speed of the turbine is proportional to the flow of water in the intake, and the device for feeding each chemical solution consists of a revolving disc on which are mounted small buckets which dip into the solution, the level of which is held constant by float control after the manner commonly obtaining in orifice boxes. The buckets discharge into a trough, from which direct pipe connection is made to the suction well. The speed of the buckets is adjustable over a wide range by friction disc drive from the turbine for any strength of solution or rate of dosing. The device arranged for two solutions is shown in Fig. 3.

Previous to the year 1917, it was necessary to hold steam at 40 lbs. pressure on the boilers as reserve for the steam pumps for fire service, and for occasions when electric power went off. The cost of this reserve becoming serious with the rise in price of coal during the war, it was decided to replace this part of the plant with two gasoline-operated units drawing water from the new suction well, and to abandon the old well and intake.

One of these units was installed about a year ago in place of one of the steam pumps, and consists of a 1,200 g.p.m. pump coupled to a six-cylinder engine, running at 1,500 r.p.m., complete with electric starting motor and storage battery, this battery being maintained in proper working condition by a small generator which can be operated at any time by belt from the coupling of one of the motor-driven domestic pumps. This unit is shown in Fig. 1.

The main gasoline tank is located in the usual manner, underground and outside the building, with the gasoline pump and auxiliary tank in a small concrete annex, an extension shaft and tell-tale passing through the wall for the purpose of operating the pump from inside the station.

The cost of this unit installed was about $7,000.

An automatic valve has been designed for cutting off the gasoline from the engine should the operator forget to do so when he shuts down the unit, in which case a leaking carburetor valve might allow gasoline to escape. This valve is controlled hydraulically from both the suction and discharge of the pump, and operates when the engine stops, independent of pressure on the pump from the town mains.

It has been sought by the above arrangement, and by fire walls and fire doors separating the electrical from the gasoline equipment, to make the gasoline reserve for fire thoroughly reliable and satisfactory when in charge of competent operators.

The total capacity for fire service under 100 lbs. pressure amounts to 3,400 g.p.m., made up of 1,200 g.p.m. for the gasoline unit, 1,700 g.p.m. for the electric units and 500 g.p.m. for the steam plant.

The steam unit is to be replaced with a second gasoline unit, and an additional unit for domestic service is under consideration.

The book value for the filter plant is $8,700, and for the electric pumping plant $9,200.

CANADIAN GOOD ROADS ASSOCIATION

AT a meeting held last Thursday in Toronto, the executive committee of the Canadian Good Roads Association decided that the 1920 congress and exhibition should be held in Winnipeg. Plans were also discussed for an educational campaign for the purpose of stimulating interest in the good roads movement, and to insure that full advantage will be taken of the federal grant of $20,000,000.

Details of the educational campaign will be announced after another meeting of the committee to be held September 25th in Ottawa, but it is understood that this campaign will consist of the use of a limited amount of display advertising, and the preparation of interesting articles for use by the newspapers as reading matter. An office will be opened in Montreal and a staff engaged in order to carry on the work upon a more energetic basis. Contributions will be received from any interested firms or individuals, and it is expected that aid will also be secured from the Dominion government and the various provincial governments.

Regarding the selection of Winnipeg, it is interesting to note that this will be the first time that the congress has gone west of Toronto or Hamilton. Winnipeg was selected for the place of the convention in 1917, but owing to railway congestion and other war-time conditions, plans for holding the convention there had to be abandoned, and it was held in Hamilton instead. These difficulties have now disappeared, and the Manitoba members of the association are enthusiastic about obtaining the convention next spring for their province. Interest in good roads is increasing throughout the west. Vancouver has already requested the 1921 convention.

The executive committee of the association consists of S. L. Squire, Toronto, president; Andrew F. Macallum, Ottawa, first vice-president; Geo. A. McNamee, Montreal, secretary-treasurer; Russell T. Kelly, Hamilton, director; and J. A. Duchastel, Montreal, past president.

PUMPS FOR SMALL WATER WORKS*

By Henry A. Symonds
Boston, Mass.

IN designing a plant for pumping water for a small community, it is usually the case that the per capita cost of operating and maintenance is greater than in the large city plants, and it is important that a careful study be made of the relative merits of the different forms of power available, their adaptability, first cost, and efficiency when operating to do the particular work desired.

It is usually the case that strict economy must be practised in the introduction of these works, and studies relative to first cost have usually been made to bring the cost of the work within the ability of the communities to pay. Not so much attention, however, has been paid to the question of relative efficiency and daily cost of operation, and it frequently occurs that plants are in operation which citizens of the town, and even the water works officials themselves, believe to be highly economical, and that are the reverse. The difference in cost of operation may be so great as to make it good business to pay a much higher price for an economical unit.

Water Power—The early use of power for pumping water in the small-town installations was largely by water power or steam, and it is possible that water power is coming back into use for pumping purposes, but probably through the medium of the hydro-electric plants, as it is not common to find good water privileges so located as to be directly available for pumping from the approved sources of water-supply.

Steam Pumps—Steam has been used for many years very efficiently in many small plants.

Steam Turbines—The development of the centrifugal pump, which has now found so wide a field, was closely identified with the bringing out of the steam turbine.

The Ideal Small Pumping Plant

The centrifugal pump has been known for a great many years, but for a long time after it was invented the difficulty of getting suitable drive with sufficiently high speed retarded the development of successful operation of this type of pump. The real growth of this pump has occurred in the past ten years, during which time the use of the steam turbine and the electric motor with direct connection to the centrifugal pump has brought up the efficiency of the pump to a relatively high stage. At the present time the use of the steam turbine as applied to pumping water is mainly in the large units, and the motor is generally adopted for driving the smaller plants.

The result of the use of steam is, on the whole, satisfactory, but for the small water plants it is subject to the objections that the economical pumping machines with boilers are expensive and occupy much space, and provision for large storage of coal and adequate pumping-station buildings are required, all of which conditions add to the first cost of the plant and are aggravated by the fact that licensed engineers are required to operate such a station.

To-day we consider the ideal small pumping engine that which is economical in first cost, and is self-contained; i.e., operates from a source of power which is part of the engine or at least located in the same station. It is desirable to have it occupy as small space as is practicable, be simple in operation and not require the services of licensed men, easily repaired, quickly started, using fuel which is readily available at all times, and be capable of producing power at a relatively low unit cost.

Electric Motor—Many of the conditions of an ideal plant are met by the electric motor, and the electrical installation has become more and more common. The advantages are: Low first cost; it requires little space; low cost of maintenance; no expert supervision; it is especially well adapted to drive centrifugal pumps with direct connection, which saves friction loss of gears, and prevents noise; it may have automatic control; it may operate during periods of low load at central station, thereby getting lower rates; instant starting; as it has no reciprocating parts, it can be left to operate without attendance better than any other form of drive. The use of electricity has two serious defects in the average municipal plant; namely, it is not self-contained, but depends upon a line of wires and a power plant, usually at a distance, for its operation. For this reason neither one nor two units in a pumping station operated from the same plant are satisfactory to the insurance authorities, as they rightly claim that an accident to the wire line or the power plant will put both units out of use as quickly as one and leave the town or city in an unprotected condition in case of fire.

Attendance the Large Item of Cost

The advocates of the use of motors base their claims of low cost of operation upon the fact that attendance may be a minimum and that this is really the large item in operating small water plants. The writer believes that this argument has considerable merit, and that the improvement in efficiency brought about recently in the centrifugal pumps, and the low cost of the pump and motor, with the advantages above referred to, make this form of pumping plant a very close competitor of, and in some cases it will be found actually to be a better business proposition than, the other types of pumps and engines in spite of the difference in efficiency.

Gasoline Engine—Another form of drive which has been used in some of the small pumping plants is the gasoline engine. This form of power has practically all the advantages above mentioned except cost of operation, and in this it falls down badly, as it is operated upon a fuel of such high cost as to make the operation per horsepower-hour too high for practical purposes in the ordinary municipal water works. However, in plants where an emergency unit is wanted and electricity is not available or desirable for any reason, the gasoline engine may meet the requirements in a satisfactory manner.

Producer Gas—The gas producer as a source of power corresponds to the boiler in a steam plant. It has a great many advantages, and when combined with a proper engine for utilizing the gas to the best advantage may be considered as having most of the requirements of the ideal plant.

Comparative Fuel and First Costs of Various Types of Pumping Plants for Small Water Works

1,500 g.p.m., 250-ft. total head; operating 300 days per year, nine hours per day; theoretical h.p., 94.7.

Pump.	Drive.	Pump efficiency per cent.	H.p. required.	Cost of fuel per h.p. hour.	Total fuel cost per hour.	Fuel cost per 300 days.	Estimated cost of plant.	Remarks.
Vert. triplex	Fuel-oil engine	85	112	$0.004	$0.498	$1,209.60	$17,189	Guarantee—1 h.p. for 0.55 lb. fuel oil per hour. Price fuel oil, 4c. per gal.
Centrifugal	Fuel-oil engine	71	134	0.004	0.536	1,547.20	16,343	
Vert. triplex	Steam turbine	85	112	0.0075	0.840	2,268.00	13,657	Coal at $6 per ton (2,000 lbs.)
Centrifugal	Steam turbine	71	134	0.0075	1.005	2,713.50	9,957	
Vert. triplex	Electric motor	76	125	0.0124	1.55	4,185.00	11,115	Efficiency is combined pump and motor. Electricity cost, 0.9c. per h.p.-hr. plus "service charge" of 77c. per h.p., based upon max. h.p. in use, per month.
Centrifugal	Electric motor	64	148	0.0124	1.84	4,968.00	6,248	
Cross-compound, fly-wheel, steam pumping engine						1,350.00	17,000	
Compound-duplex-Deane steam pump (original plant). Rate about 700 g.p.m.						2,725.61		Actual figures of present cost. Rate of pumping about 700 g.p.m.

*From the Journal of the New England Water Works Association.

This form of power has been used for some time, and, so far as the writer has record, with good satisfaction in all cases. Gas produced in this way may be used in various types of internal-combustion engines with slight modification. A plant of this kind can be installed at reasonable first cost, is self-contained in so far as the power is generated directly next to the engine itself, and operates at a remarkably low cost upon a relatively inexpensive form of coal. The plant takes up more room than some of the other types, and calls for a larger pumping-station space.

Fuel-Oil Engines—In the writer's experience, in nine cases out of ten fuel-oil engines have proved an ideal installation for plants from 25 to 150 h.p., and for this reason it may be proper to give some extra details regarding this engine. The term "fuel-oil" is here used to mean any oil, from the heavier crude petroleum up to kerosene.

Fuel-oil engines are to-day known under two general heads as Diesel and Semi-Diesel, or surface ignition.

Semi-Diesel Engines

The idea conceived by Diesel is the bringing into compression a mixture of air and oil vapor to a point where heat is generated sufficient to ignite the combination. The compression reached varies from 500 to 1,100 lbs. per sq. in., but when the proper temperature occurs the gases burn rather than explode, and it is the claim of the producers of the Diesel type that this slower burning conserves the power of the gases, and the energy realized is utilized almost entirely in pushing the piston through the length of its stroke. In order to permit of the great pressure produced by this process, the machine must be exceedingly heavy, and the great amount of work which is required to perfect the Diesel engine makes it too expensive for the ordinary requirements of small water-supply plants.

The Semi-Diesel, or surface-ignition engine, on the other hand, gets its power by the explosion of a mixture of air and oil gas in the cylinder under compression around 200 to 300 lbs. per sq. in. While part of the energy is undoubtedly used in the shock against the metal of the plunger and cylinder, the resulting thrust produces motion of the piston, which is connected through the crosshead, or directly to a crank shaft which gives the motion to the driving pulley or gear.

The Semi-Diesel seems to meet all the ordinary requirements of the ideal engine described above, and while the first cost of this engine is considerably greater than that of the gasoline engine or the electric motor, the operating costs are so low that this outweighs in most cases the advantages of the low first cost of the other machines.

Poor Fuel Oils Satisfactory

In the types which are considered as small pumping outfits, designed to pump the water for communities of from 1,000 to 10,000 inhabitants, the engines required ranged from 25 to 150 h.p., but in the writer's opinion there is a large field for a still larger oil engine, and there are some machines now being produced that show wonderful efficiency in operation. They are of the Semi-Diesel type, but are able to operate on the poorest grade of fuel oil, and even tar products which have to be heated before it is possible to get them into the cylinders. The oil used runs as low as 18 degs. Beaumé, while in the smaller machines—that is, below 60 h.p.—the writer knows of good results with oil heavier than 26 degs. Beaumé, and with 25 to 35 h.p. engines kerosene or light oils of that grade have seemed to give the most satisfactory results. Pre-war prices ranged from 2 cents to 7 cents for the various grades.

The ordinary time of starting with fuel oil is from 12 to 18 min., but engines of this type may be equipped with apparatus which permits of instant starting by electric ignition and gasoline, the fuel oil being turned on after a few minutes, without interruption of the operation of the engine. This latter contrivance is of especial value where but little storage of water is possible and pumps have to be operated in case of fire, as the delay in heating the cylinder head may be serious if the supply of water is not available.

It is claimed by the advocates of the electric motor, in comparison, that the motor requires little attendance, while the oil engine calls for constant supervision. This claim is not entirely substantiated in practice, for many of the oil plants are operating for long periods of time without attendance. This of course assumes that there are duplicate units which will take care of any fire hazard if repairs are necessary. It should also be considered that constant attendance does not eliminate many of the breakdowns.

Perhaps the most satisfactory combination that can be installed for a small pumping plant for general municipal needs is made up of two duplicate units, of which it is probable that the fuel-oil engine meets the needs fully as well as any other drive which has been developed up to this time.

One advantage, of considerable importance in some cases, that steam machines have over most of the other types is in the varying of speed in operation. The speed in the electric motor and of the internal-combustion engines is variable only to a small extent, except by change gears or belt pulleys, and it is sometimes necessary to pump to waste or through a bypass back into the suction, an uneconomical process, in order to keep the rate of delivery as desired.

Comparison of Costs

The writer had occasion, a short time ago, to make a comparison of different types of pumping plants, to determine which plant would best meet the needs of a community. In connection with this, the results of investigation of different units were tabulated and are given on page 289. The figures are not to be considered as exact, either of operation or first cost, but are obtained by using quotations and guaranteed efficiencies by the manufacturers of the different lines of machinery. These figures were also taken before the extreme rise of prices which occurred since the United States entered the war, and, while they are far above the averages of five years ago, it is probable that they are nearer what we may expect in the next few years than pre-war prices.

WILLIAM ARMSTRONG RETURNS TO CANADA

WILLIAM Armstrong, who was formerly Canadian representative for a number of English manufacturers, has returned to Canada after four years of war work, and is again acting as Canadian agent for several prominent overseas firms. When war was declared, Mr. Armstrong happened to be in Vancouver. He left for New York and sailed for England, where he enlisted as a lieutenant in the admiralty, and was assigned to engineering duties on board one of the warships. Shortly afterwards, however, he was appointed technical officer in charge of mine production, and when the armistice was declared he held the rank of acting-commander. Under Mr. Armstrong's direction approximately 3,500,000 mines were manufactured, largely by electric welding.

The agencies which Mr. Armstrong has undertaken are as follows:—

Quasi-Arc Electric Welding Co., covered electrodes and resistances for use in electric welding; Sturgeon Centrifuge Co., centrifuges of various types for clay drying, sewage disposal, etc.; Hick, Hargreaves and Co., condensers, Diesel engines and steam engines; Jos. Booth Bros., Ltd., electric overhead travelling cranes; T. F. Braime and Co., seamless specialities in all metals; Yeadon, Son and Co., briquetting machinery; Head, Wrightson, Ltd., colliery apparatus and blast furnace plant; Sankey and Son, Ltd., steel wheels for automobiles; British Electric Vehicles Co., electric trucks for conveying baggage at railway terminals, handling shipments from warehouses, etc.; Jos. Carter (Stalybridge), Ltd., rubber-working machinery.

The president of the Draftsmen's Association, which has been organized in Toronto, is Geo. H. Rix, of the C.N.R. staff. The secretary is Arthur E. Fetherstonhaugh, architect, 234 Kingswood Rd., Toronto. Meetings will be held the second and fourth Fridays of each month during the fall and winter.

STREAM FLOW AND PERCOLATION WATER*

By Samuel Hall
Assistant Water Engineer, Belfast

THE author, many years ago, commenced investigations of the conditions which govern and control the ever-varying flow of streams and rivers, conceiving that, even were no definite laws established, he might gain a better knowledge of the subject, and information of practical value. The author considers that the agreement between data and facts from widely different sources is such as to fully warrant the statements made in this paper. The subject is treated broadly, and in order to make it clearer many well-known conclusions are repeated.

Fig. 1 is a flow curve showing inconstant rates of discharge for a period of 24 days, and some features characteristic of probably all stream flow curves, the most noticeable being the "peaks" following rainfall, showing immediate increase of flow attributable to surface run-off. Another feature is the slowly falling parts obtaining in rainless periods, when the flow is that of percolation discharge alone. The curve shown represents the flow from a mountain catchment of between 2,000 and 3,000 acres in extent, and is taken from automatically recorded diagrams of depth of

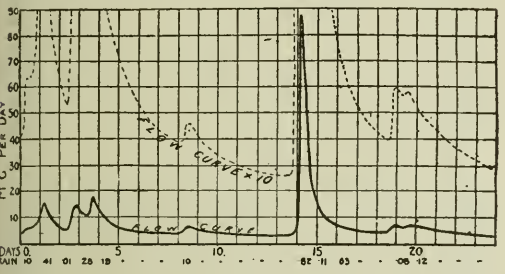

FIG. 1—STREAM FLOW CURVE

water over a weir. It shows quick "run-off" and very marked, yet not exceptional, variations of flow.

Before comparing "peaks" of different streams, it will be interesting to compare those of one stream. They are greatest in proportion to rainfall when the surface soil is moist, always large in winter and after wet weather gradually smaller as summer advances, and smallest near the end of a long period of drought, when they contrast greatly with those of other periods. The rate of rise to a peak, when other conditions are the same, is a rough measure of rainfall intensity, which affects the height of the peak and flood rates. The falling part of the peak curve is generally slightly "slower" than the rising part, and becomes still slower as it descends. It indicates the rate of surface drainage after rain has ceased, and appears to be of some approximately regular form, but is, of course, modified by the amount of percolation discharge. The gently falling and lowest parts of the curve due to percolation discharge are generally gradually higher from the autumn and lower from spring to the end of summer, being lowest at the end of a long drought. One characteristic of these parts is the steady fall of the curve, showing not only that the rate of flow decreases, but that its rate of decrease also diminishes; in other words, the curve gets flatter from day to day throughout a rainless period. Towards the end of a drought the diminution is so small that the curve might appear to have become a horizontal line, yet examination of a greater length of curve will suffice to show such a conclusion is wrong; but it appears probable that a slowly diminishing flow might be continued during perhaps a year of further absolute drought. Some streams in these islands occasionally run dry, yet the larger streams and rivers have substantial discharges in droughts which are but of short duration compared with those which occur in some other countries. Another feature to which attention must be drawn is that the position of these parts of the curve is raised after every peak occurs. To make this clear, let us imagine a prolongation of the curve obtaining before the peak, on the line it would probably have taken had the rainfall not occurred. The produced curve would, apparently in every case, lie some distance below that which actually obtains after the peak, and the amount of difference between the produced and actual curves appears to be roughly proportionate to the extent of the peak. It seems to be clear that not only has there been a large immediate yield as shown by a peak, but that the stream has gained in "staying power." The conclusion drawn is that new supplies of percolation water have increased the amount in store, with the reslut of increased discharge. The effect of frost is, in general, precisely the same as that of absence of rain. Frost does not affect the percolation discharge, except perhaps where such occurs as small surface springs, but it holds up surface "run-off." Snow, of course, does not affect flow until thawing takes place.

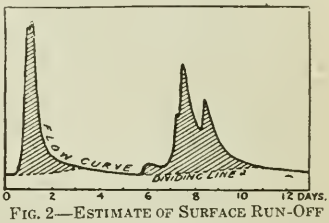

FIG. 2—ESTIMATE OF SURFACE RUN-OFF

In comparing curves of different streams it may be seen that the slope of the ground is a factor which affects the rates of rise and fall, and also the size of the "peaks," no doubt because less slope and slower "run-off" allows surface water to remain for a longer period under percolation influences. The length and slope of the stream courses are factors influencing chiefly the shape of the peaks, because after water has supplemented the flow in the upper reaches of the stream some time elapses before the effect is recorded at the gauging point. This time, roughly determinable, is a matter of hours for small streams, but of days for large rivers. Every stream course has a slight temporary storage effect, which is increased where the banks are permeable and extensive.

In order to form a rough idea of the extent to which the nature of the drainage area affects the peaks, we may assume the case of a river fed by a number of streams of similar drainage areas at various points. The effects of spates on each stream would be recorded at times, varying roughly according to the distance of the points of confluence from the gauging station. Tracing the flow curve of one stream, and altering the time for each so that if superimposed the peaks would show one after the other, the sum of these stream flow curves representing the total flow of the river, would obviously show less rates of rise and fall, and a less maximum rate in proportion to the total drainage area. Though other factors might modify the curve, the logical conclusion is that increase of size means flatter peaks and smaller maximum or flood rates in proportion to the area, whilst the converse holds for smaller areas.

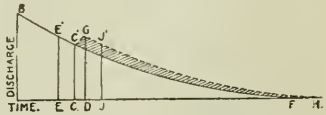

FIG. 3—TANK DISCHARGE CURVE

"Dry weather flow" is used by various engineers to mean either minimum known flow, or that for one year (average), or occasionally a supposed irreducible and constant rate which would obtain under any exceptionally adverse conditions. As a term so variously interpreted cannot lead to anything but confusion, what is meant should be expressed in other words. The minimum rate of flow is seldom the same in any different years, and any particular minimum only holds good till a lower one is recorded.

The sources of supply due to precipitation can be classed as: (1) Surface run-off; and (2) percolation discharge.

*From a paper read before the Institution of Water Engineers of Great Britain.

The chief source of deficit between rainfall on the area and resultant flow is evaporation loss. Another source of deficit is the loss of percolation water, which is inevitable, though it might be small in amount; but, on the other hand, this loss might be more than compensated for by gains of percolation water from sources outside the topographical drainage area.

(1) *Surface Run-off.*—That part of the rainfall which falls on the water surfaces as a "direct contribution" to the stream is measurable by the product of rainfall and water area. It causes the first upward turn of the curve at a peak; normally small in amount, it becomes a greater proportion of peaks towards the end of a period of drought, and might at such times be the only benefit from rainfall.

Some of the factors affecting surface run-off have been already mentioned. Absorption and percolation are factors which are probably not of equal effect over the whole of the drainage area, and also vary according to weather conditions. Surface run-off will occur when and where the rate of rainfall exceeds the rate of absorption until the surface soil is saturated; then it depends upon the difference between rates of rainfall and percolation.

The proportion of rainfall yielded as surface run-off is high when the ground remains frozen, and is generally very small in summer, sometimes very large, however, after the ground has been "baked," but whether this is actually due to the "baked" condition of the soil or to greater intensity of

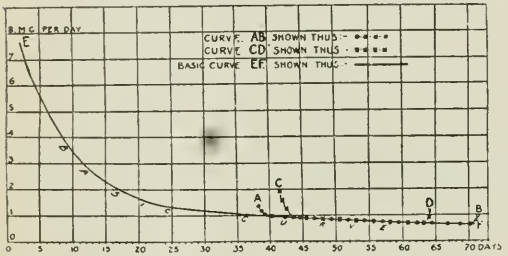

FIG. 4—BASIC CURVE OF PERCOLATION DISCHARGE

rainfall, such as obtains in thunder showers, has not been satisfactorily determined. The author has observed in ground over clay subsoil that extensive and frequent cracks develop during droughts, and it is questionable whether such cracks, at times two inches in width and more than a foot in depth, would not counter-balance the effect of baking the ground.

Whilst the ground is under the effect of recent rains, a subsequent rainfall produces a greater result in the amount of run-off. A few hours after rainfall has ceased it would be very difficult to detect, on the gathering ground, any indication of surface run-off (except where flooding has occurred), though it is quite noticeable during heavy rains from the newly formed streamlets appearing in ill-formed and miniature valleys in the drainage area.

In estimating the time at which it becomes *nil* or negligible, the fact of thin films of water being almost unnoticeable should be taken into account, and the author's estimate of the time which might elapse before the surface water has reached a stream course is given as seldom more than 48 hours, but variable according to the amount of rainfall, percolation rate, and surface slope. On this assumption dividing lines have been inserted in the flow curve in Fig. 2, to show an estimate of the increase of flow due to surface run-off; this is shown by the cross-hatched portions. By treating all the peaks in the same manner, an estimate of the yearly total of surface run-off can be made. The amount of flow, as shown by the low-lying parts of the curve, and up to the dividing line or lines is likewise an estimate of the percolation discharge. Where rainfalls succeed one another, the guide to the insertion of the dividing lines should be the estimate of percolation discharge, which has but a slowly increasing rate, and the dividing lines must obviously commence at a part of the curve which indicates percolation discharge alone. In the case of large rivers, allowance for the time taken in flowing down the river will be necessary, but percolation discharge will be the best guide for estimating purposes. It is not, of course, possible to determine accurately what proportion is due to the two intermediate sources of supply, but it will be noted from Fig. 2 that were the time of 48 hours altered to 36 or 60, it would not affect the estimate very materially.

The area from which surface run-off occurs is obviously defined by the natural water partings, but it must be noted that this area is not necessarily identical with the percolation drainage area.

Conditions Affecting Percolation Discharge

(2) *Percolation Discharge.*—Of percolation discharge there is visible and irrefutable evidence in the existence of springs discharging percolation water at the surface of the ground. There are also subaqueous springs discharging into the beds of streams, rivers and the ocean less apparent and likely to escape notice. There are doubtless similar discharges of percolation water which, from finding easy passage through alluvial deposits to open water, are perhaps outside the possibility of detection. Considering that almost all rocks are fissured, and that the beds and banks of streams are, as a general rule, extensive alluvial deposits, it is most probable that a surface discharge occurs as an exception rather than a rule. There is no better evidence of the temporary storage of considerable volumes of percolation water than stream flow when the surface soil is parched, for at such a time the whole of the flow is obviously from such sources. So far as stream flow is concerned there is no need to make any distinction between visible spring flow and other percolation discharge, as the laws which apply to one apply with equal force to the other, and to percolation discharge as a whole.

The geological conditions of the drainage area affect percolation storage and discharge, yet in the author's opinion physical conditions have often greater influence. For example, the same bed of grit may be in one locality very much fissured, and in another considerably less so, and such differences mean like differences in storage capacity. Limestone, granite, other compact rocks, and also alluvial deposits, likewise differ in storage capacity in fissures and interstices. The rate of discharge also depends probably more on physical than geological conditions, and the greater width of an outlet for percolation water might be merely accidental. The volumes of water which can be absorbed by compact rocks after they have been heated to dryness is very considerable; yet this should not be taken into account, as all the deep subsoil rocks are, and remain, moist whilst *in situ*, and the amount they can retain, despite the force of gravity, is most probably constant. For these reasons the author strongly inclines to the belief that it is the fissures, and not the compact rock, which yields the percolation discharge. There will doubtless be cases where the water percolates through compact rock; but where fissures occur, they provide much quicker drainage for the bulk of percolation water.

Percolation and Hydraulic Laws

It is not proposed to consider the subject from a geological point of view, but to consider how far percolation discharge is subject to known hydraulic laws, and in order to do that it is necessary to consider the physical conditions which affect storage and discharge. Percolation water, having passed through surface soil into permeable strata, trickles downwards through interstices and fissures until its downward progress is stopped by impermeable strata, or until it reaches an existing water surface. Its course afterwards, in either case, is most probably like that of water in open channels, to which fissures and large interstices in the strata are a rough parallel. Each fissure or miniature channel has its rate of discharge and a hydraulic gradient inseparably related to the discharge rate. The hydraulic gradient is, of course, the water surface. The surface of percolation water in a network of fissures and interstices, assumed continuous through intervening rock, has been termed the surface of saturation, but is more generally called sub-soil water level. It is really a network of hydraulic gradients, and for any particular position there is a related flow, or rate of discharge. Its slope depends partly on the size and

extent of the fissures, which, being usually of small size, will have steeper gradients than those which we usually associate with open channels. The surface of saturation is not level; it bears no relation to the surface of the ground, but inclines towards the outlets for percolation water, and it coincides with free water surfaces. Its position is not fixed, but is slowly altered by discharge and supply; and should supply disturb the hydraulic gradients throughout the surface of saturation, there is a natural tendency to settlement to some position which corresponds throughout with a particular discharge rate.

The conclusions are that where part of the rainfall can percolate to the deeper subsoil, a surface of saturation is formed in the fissure and interstices of the rocks, and that there is a rate of percolation discharge corresponding to each position of the surface of saturation, and such conditions will generally obtain. Where clay immediately underlies the surface soil, discharge conditions are perhaps slightly different, but the author has not had an opportunity of investigating such a case.

Subsoil Storage Reservoirs

The conditions of storage of percolation water may not always be the same as those mentioned, for it is quite possible there are what might be termed natural subsoil, but leaking storage reservoirs, the discharge from which might be considered as from a reservoir outlet pipe. In such a case hydraulic laws would apply, and the discharge would have its related "head" and its hydraulic gradient. The author has evidence in two cases of excavations which pointed to the existence of leaking subsoil storage reservoirs. In one of these cases the volume of water was large, and the annual variation of water level small, sufficient to show that if leakage did occur it could have been continued for at least a year of absolute drought.

In considering how the available quantity of percolation water might be approximately determined from percolation discharge, it will materially assist if we first consider conditions affecting the discharge from a tank. The discharge rate or flow curve from a pipe outlet from an irregularly shaped tank would be of some such form as shown by the firm line E^1F in Fig. 3, the rate of discharge at any time being represented by an ordinate of the diagram at that time; thus E^1E represents the rate of discharge at the time E. Having the whole diagram, the total discharge is measurable; the total discharge represents the "storage capacity" of the tank, which is thus determined by means of the flow curve alone. Let us call this curve (E^1F) the basic curve, and note that any rate of discharge denotes a related position of the water level in the tank, and some corresponding amount of storage. It is quite obvious that if the tank were again filled, the basic curve would be reproduced; and if the rate of discharge at a given time be ascertained, the subsequent rates of flow, or the total available flow, can be foretold from the basic curve, no actual observations of the water levels in the tank being necessary. When a fresh supply of water is poured into the tank, it results in a corresponding alteration in the flow curve, which repeats some part of the basic curve after the supply is stopped, and by means of the basic curve the amount of supply can be determined.

Hydraulic Similarity

This case is illustrated by the dotted line in Fig. 3, which shows the effect of a fresh supply. After the supply has been stopped, the flow curve GH is a repetition of a part of the basic curve. The rate DG being the same as EE^1 at some point on the basic curve, the curve GH is the same as the curve E^1F. It is obvious that the amount of the fresh supply has caused the increase of flow shown by the shaded portion of the diagram, and the difference between the total discharges as shown by the curves C^1GH and C^1F obviously shows the total amount of the fresh supply. The latter is also measurable in another way; the ordinates EE^1 and DG are equal, and show that the quantity of water in the tank at the times E and D was the same; hence the total discharge between the times E and D as shown by the curve E^1C^1G was the net gain, or the amount of fresh supply. Similarly, by locating the time J when the ordinate JJ^1 is equal to CC^1, the total discharge between the times C and J, shown by the curve C^1GJ^1, is also equal to the fresh supply. The last mentioned is the method which appears most convenient for ascertaining the amount of gains accruing from rainfalls.

It must be borne in mind that it is a short method of measuring total gain, which, as shown by the shaded portion in Fig. 3, causes an increase of flow over a considerably longer period than that denoted by the time CJ. The aggregate percolation discharge from a drainage area is really a number of discharges from different ill-defined and overlapping areas, and may be likened to that from a series of tanks having various rates of discharge and various rates of supply, making it doubtful whether the principles would hold good; yet the average rate of supply to each tank governs the rates of discharge to a considerable extent; thus, when supplies are small low discharges prevail, and the converse of this also holds good.

The supply to percolation storage is "available rainfall," the governing influence of which is best illustrated by the fact that streams and rivers throughout the country show lowest flows at about the same times. It is now proposed to apply the above-mentioned principles, which are based upon well-known hydraulic laws, to percolation discharge, which is believed or assumed to be subject to the same laws, and should tests indicate agreement, it might reasonably be presumed that the assumption is correct.

Basic Curve of Percolation Discharge

Let us now suppose that after a period of considerable percolation the natural storage of percolation water is as great as it can be, that the stored water receives no further supply, but is exhausted by discharge. The flow curve obtained during this period, hereafter called the "basic curve of percolation discharge," would be a parallel to the basic curve of the hypothetical tank discharge; and whenever similar conditions obtain, some parts of the basic curve should be reproduced between times of fresh supplies. Let us now test the actual stream flow curve to see whether or not it does behave in this manner; for if it does, we might, from these reproduced parts, construct a considerable length of the basic curve. The method of testing is as follows: Reproduce on a diagram the flow curve shown during an absolute drought in which the lowest flow is measured, as AB in Fig. 4. (The curve in that figure is shown by a series of dots for the sake of clearness.) Reproduce a second drought flow curve in which the second lowest flow is measured, as CD, so that the ordinate showing the second lowest rate coincides with the ordinate of the first curve showing the same rate. Then, if the principles apply, a length of the second curve will coincide with a length of the first, and the coinciding portions show a length of the basic curve. Similarly, other drought or rainless period lengths of the stream flow curve can be reproduced until the greatest available length of basic curve is obtained. It is recommended that a tracing of the basic curve be then applied throughout the stream flow to test whether the flow curve in all rainless periods reproduces a part of it. The author tested in this manner the basic curve as shown by EF in Fig. 4, and found that the discrepancies were so slight that they may have been due to variations of evaporation from the stream surface. For accuracy, fine readings are necessary, particularly where the flow curve is almost flat, but in two cases the author obtained basic curves where only rough daily gaugings were given, and these showed agreement with actual flow in rainless periods as nearly as it was possible to ascertain. The stepped curve of daily gaugings was replaced by one passing through the middle points of the horizintal portions. The basic curve as shown by EF in Fig. 4 agreed with the stream flow curve from three to five days after rainfall had ceased; towards the end of this period the difference between the two was slight, but such as to shorten the times at which the basic curve was applicable; and this period was in another case apparently from four to as much as ten days, and in each case varied as the yield from rainfall was smaller or larger.

It will be obvious that the basic curve of percolation discharge is not capable of application at times when there is both surface run-off and percolation discharge, and that

its use would be strictly limited to the times at which the flow curve of the stream has assumed the basic curve form, and it is important that this should be noted. When the former has assumed agreement with the latter for even a short distance, the basic curve can be used, in precisely the same manner as that obtained from the hypothetical tank discharge, to foretell subsequent rates of flow which would occur in the absence of fresh supplies to the limit of minimum flow previously measured, and to state the time at which that limit would be shown; also to determine the volume of percolation water available in the meantime. Where times of application permit, the fresh supplies form periods of rainfall, *i.e.*, the available percolation supplies, and occasionally that due to a particular rainfall, also the difference between the respective amounts of available percolation water in store at different times, can be determined. It may be noted that the length of the basic curve was determined only to certain limits, but this fact does not prevent its use. An estimate of its continuation could be made for the purpose of determining probable minimum flow under worse conditions, but otherwise would not be necessary.

When a tracing of the basic curve is applied to a flow curve at a time before a peak, to show how the latter would have continued in the absence of rain, the difference between the two curves shows the increase of flow which the rain has caused. So much of the increase as is due to increased percolation discharge would be of similar form to the shaded portion of Fig. 3. The maximum benefit from this source is shown to occur a short time after rainfall, but the benefit continues for a very long period (it might be contended, forever) at a slowly decreasing rate. As a corallary, it might be expected that the total percolation discharge at any time depends upon the amount of percolation which has obtained during many preceding months, and the effect of percolation during a particular month is reflected most largely in the next month, and to a less and less extent in each succeeding month. Examinations of many flow curves have confirmed this fact.

(Concluded in the next issue)

BRITISH ENGINEERING STANDARDS REPORTS

CAPT. R. J. DURLEY, secretary of the Canadian Engineering Standards Association, announces that a stock of a number of the most important publications of the British Engineering Standards Association has been received at his office, and can be obtained by any interested person upon application to him at Room 112, West Block, Ottawa. The accompanying list does not include all publications of the British Engineering Standards Association, but covers those of recent issue. Copies are for sale at twenty-five cents each excepting for the last-mentioned report (No. CL3,750) which is fifteen cents, these prices being net in all quantities. Orders for copies should be accompanied by postal note or money order payable to the Canadian Engineering Standards Association. Following is Capt. Durley's brief description of the publications now in stock:—

Report No. 15-1912. Revised August, 1912. *British Standard Specification for Structural Steel for Bridges, etc., and General Building Construction.*—This report covers process of manufacture, quality of finished steel, tensile tests, bending tests, tests on rivets, chemical analysis, inspection and other conditions.

Report No. 63-1913. *British Standard Specification for Sizes of Broken Stone and Chippings.*—This specification was formulated as a result of conferences between the quarry owners and road authorities and gives standard nomenclature, definitions and methods of measurement for broken stone and chippings.

Report No. 65-1914. *British Standard Specification for Salt-Glazed Ware Pipes.*—This report contains tables of dimensions and particulars regarding sockets, grooving, glazing, permissible variation in thickness and diameter, and methods of testing for strength and absorption.

Report No. 21-1909. Revised November, 1909. *Report on British Standard Pipe Threads for Iron or Steel Pipes and Tubes.*—This report gives definitions and tables of dimensions for British standard pipe threads. In this system the Whitworth form of thread is employed, but fine pitches are used, and both parallel and conical screw ends are provided for.

Report No. 44-1909. *British Standard Specification for Cast Iron Pipes for Hydraulic Power.*—Provision is made for two classes of this pipe, together with bends, tees and special castings. Class A: Working pressures from 700 to 900 lbs. per sq. in. Class B: Working pressures from 900 to 1,200 lbs. per sq. in. The specification covers quality of material, permissible variation of weight, marking, testing, inspection and tables of dimensions and weights.

Report No. 37-1919. Revised January, 1919. *British Standard Specification for Electricity Meters.*—This specification is intended to apply to the purchase of new meters, governing their sale by the manufacturer to the purchaser. Requirements for meters up to the largest sizes in use as well as for three-wire and three-phase meters are included. The electrolytic type of meter is not dealt with. The specification gives standard definitions and provisions regarding external characteristics, insulation, labels, standard method of marking, registering, mechanism, minimum running current, permissible limit of error and rate of registration, tests, precautions necessary in erection and other particulars.

Report No. 41-1908. *British Standard Specification for Cast Iron Spigot and Socket Flue or Smoke Pipes.*—This specification gives a schedule of dimensions and weights, with full size sections, for light cast iron spigot and socket pipes suitable for flue or smoke pipes.

Report No. 45-1917. Revised September, 1917. *Report on British Standard Dimensions for Sparking Plugs for Internal Combustion Engines.*—This report covers external dimensions only, the form of thread used being a metric thread having a 60 deg. angle. Tolerances on full diameter, effective diameter and core diameter for the thread on the plug and in the tapped hole are given, together with external dimensions of the complete plug and standard nomenclature of sparking plug parts.

Report No. 10-1904. Revised July, 1918. *British Standard Tables of Pipe Flanges.*—This report gives the British standard dimensions for pipe flanges for steam and water piping for low pressures and high pressures, dimensions of welded-on flanges for pipe lines for working steam pressures of 125, 225, and 325 lbs. per sq. in., dimensions for short flanged bends and tees of cast metal for pressures up to 325 lbs. per sq. in. and dimensions for long bends of wrought iron and steel.

Report No. 46-1909. *British Standard Specification for Keys and Keyways.*—The specification covers material, tests, definitions and tables of dimensions, for three classes of key: (a) Parallel sunk key; (b) taper key; (c) taper sunk key.

(Concluded on page 302)

Robert Weddell, a well-known contractor, died last week at his home in Trenton, Ont. Mr. Weddell's firm have been the contractors for a number of water-front improvements at Toronto, including the construction of the western channel and repairs to the intake.

The new million dollar laboratory of the United States Bureau of Mines will be formally opened in Pittsburgh, Pa., the end of this month. An elaborate programme of tests, visits of inspection, demonstrations of all kinds, etc., has been arranged for September 29th and 30th, and October 1st, and representatives of various universities and technical associations have been invited.

At the National Industrial Conference, which opens next Monday in Ottawa, the Association of Canadian Building and Construction Industries will be represented by: Fred Armstrong, Toronto; Col. J. A. Little, Port Arthur; H. T. Hazelton, Winnipeg; E. R. Reid, St. John, N.B.; G. H. Whitlock, Moose Jaw; and J. P. Anglin, Montreal. These gentlemen will be glad to receive any information or suggestions which will assist them in the discussion of the questions that will come before the conference.

PRESSURE RISE CAUSED BY GRADUAL GATE CLOSURE

By Norman R. Gibson
Hydraulic Engineer, Hydraulic Power Co., Niagara Falls

(Continued from last week's issue)

In the foregoing analysis no account has been taken of the effect of frictional losses of head in the penstock. As the velocity in the penstock is gradually destroyed, the friction head is gradually recovered and is added to the net head, producing discharge through the turbine gates.

Derivation of Formulas with Friction Included:—

In any penstock the total frictional losses may be assumed to be proportional to the square of the velocity of flow, and may be represented by a coefficient, F, such that FV^2 = total loss in feet of head for a velocity, V. The velocity head recovered at any time in the first interval, therefore, is $FV_0^2 - FV_{t_1}^2$. This head must then be added to the sum of $H_0 + h_{t_1}$, in determining the relation between velocity, gate opening, and head, as given by Equation (6).

Thus:—

$$V_{t_1} = (1 - t_1/T)B_0(H_0 + h_{t_1} + FV_0^2 - FV_{t_1}^2)^{1/2}$$

Squaring:—

$$V_{t_1}^2 = (1 - t_1/T)^2 B_0^2 (H_0 + h_{t_1} + FV_0^2 - FV_{t_1}^2)$$

Collecting:—

$$V_{t_1}^2[1 + (1 - t_1/T)^2 B_0^2 F] = (1 - t_1/T)^2 B_0^2 (H_0 + h_{t_1} + FV_0^2)$$

Solving and multiplying numerator and denominator by (a/g):—

$$V_{t_1} = \left\{ [(a/g)^2(1 - t_1/T)^2 B_0^2 (H_0 + h_{t_1} + FV_0^2)] \div [(a/g)^2 + (a/g)^2(1 - t_1/T)^2 B_0^2 F] \right\}^{1/2}$$

Substituting S_{t_1} for $(a/g)^2(1 - t_1/T)^2 B_0^2$,

$$V_{t_1} = \left\{ S_{t_1}(H_0 + h_{t_1} + FV_0^2)/[(a/g)^2 + S_{t_1}F] \right\}^{1/2} \quad ...(11)$$

TABLE 4—BY FORMULAS

Data: L = 820 ft. V_0 = 11.75 ft. per sec. H_0 = 165 ft. T = 2.1 sec. a = 4,680 ft. per sec. Friction neglected.

(1) Interval.	(2) Gate, B.	(3) Rise of pressure, h_t.	(4) Velocity, V
0	0.9148	0.0	11.7500
¼	0.8766	12.12	11.6684
½	0.8385	25.53	11.5740
¾	0.8004	40.41	11.4713
1	0.7623	56.96	11.3571
1¼	0.7242	69.04	11.1004
1½	0.6861	83.72	10.8205
1¾	0.6480	98.31	10.5149
2	0.6099	113.63	10.1805
2¼	0.5718	125.78	9.7505
2½	0.5337	138.05	9.2909
2¾	0.4956	150.32	8.8005
3	0.4574	162.42	8.2768
3¼	0.4193	171.97	7.6970
3½	0.3831	181.10	7.0899
3¾	0.3430	189.48	6.4574
4	0.3049	196.77	5.7994
4¼	0.2668	202.49	5.1146
4½	0.2287	207.14	4.4118
4¾	0.1906	211.00	3.6959
5	0.1525	213.79	2.9660
5¼	0.1143	215.75	2.2303
5½	0.0762	216.71	1.4887
5¾	0.0381	216.95	0.7446
6	0.0	216.67	0.0

Inserting this value of V_{t_1} in Equ. (5) for h_{t_1}, then

$$h_{t_1} = (a/g)V_0 - (a/g)\left\{ S_{t_1}(H_0 + h_{t_1} + FV_0^2)/[(a/g)^2 + S_{t_1}F] \right\}^{1/2}$$

Solving for h_{t_1} in the same manner as that used in obtaining Equ. (7), and substituting R_0 in place of $(a/g)V_0$, and Z_1 in place of $(a/g)^2 S_{t_1}/[(a/g)^2 + S_{t_1}F]$, then:—

$$h_{t_1} = \tfrac{1}{2}\left\{ (2R_0 + Z_1) \pm [Z_1^2 + 4Z_1(R_0 + H_0 + FV_0^2)]^{1/2} \right\} \quad ...(12)$$

In a similar manner, the equation for h_{t_2} is obtained by adding $(FV_0^2 - FV_{t_2}^2)$ under the root sign in Equ. (9) and inserting the resulting value of V_{t_2} in Equ. (8). Without performing the operations, which are similar to the above, the result may be written down at once.

$$h_{t_2} = \tfrac{1}{2}\left\{ (2R_{t_1} + Z_2) \pm [Z_2^2 + 4Z_2(R_{t_1} + H_0 + FV_0^2)]^{1/2} \right\} \quad ...(13)$$

Where $R_{t_1} = (a/g)V_1 + h_1 - C_{t_2}$

$$C_{t_1} = (2a/g)(V_0 - V_{t_1})$$

$$Z_2 = (a/g)^2 S_{t_2}/[(a/g)^2 + S_{t_2}F]$$

and $S_{t_2} = (a/g)^2(1 - t_2/T)^2 B_0^2$

Similarly, the value of h, at any time in any interval, may be found.

When the gate motion is not uniform, the value S_t has to be made equal to $x^2(a/g)^2 B_0^2(1 - t/T)^2$, where x is a constant or variable coefficient, which may be determined by

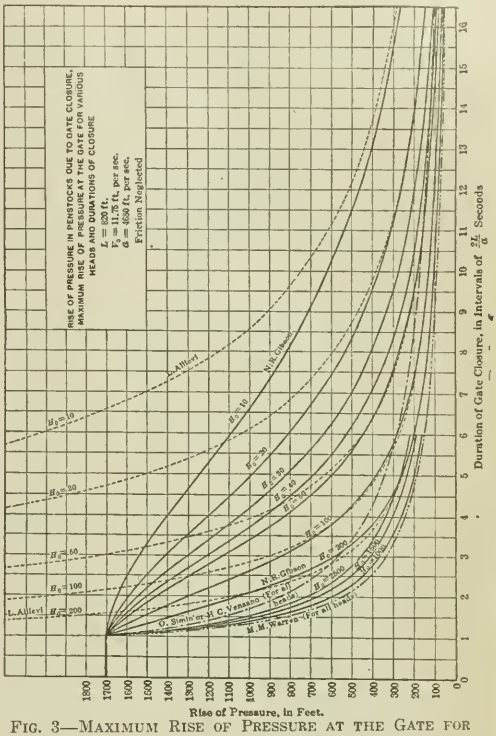

FIG. 3—MAXIMUM RISE OF PRESSURE AT THE GATE FOR VARIOUS HEADS AND DURATIONS OF CLOSURE

plotting the curve of gate opening on a time base. For uniform motion, the curve would be a straight line, the ordinate of which, at any time, t, is $(1 - t/T)B_0$. For any other than uniform motion, the ordinates of the straight line would be multiplied by the constant or variable, x, which, if the motion varied in a regular manner, might sometimes be expressed in terms of t, either graphically or analytically, from the known relation between the governor movements and the

TABLE 5—BY FORMULAS

Data: L = 6,337 ft. V_0 = 15.055 ft. per sec. H_0 = 1,260 ft. T = 69.5 sec. a = 3,647 ft. per sec. Friction head, h_f = 81 ft. Non-uniform gate motion.

(1) Interval.	(2) Gate, B.	(3) Rise of pressure	(4) Velocity.
0	0.4241	0.	15.0550
1	0.4168	18.68	14.9040
2	0.4084	39.42	14.6137
3	0.3995	25.04	14.3210
4	0.3895	80.74	13.9931
5	0.3784	86.52	13.6251
6	0.3657	44.12	13.2063
7	0.3513	62.07	12.7250
8	0.3351	59.96	12.1854
9	0.3160	68.27	11.5898
10	0.2991	76.53	10.9388
11	0.2781	87.85	10.2097
12	0.2544	99.30	9.3792
13	0.2285	110.13	8.4551
14	0.2009	118.88	7.4606
15	0.1719	128.15	6.4024
16	0.1411	136.68	5.2746
17	0.1083	145.75	4.0599
18	0.0745	156.94	2.7301
19	0.0368	156.13	1.3638
20	0.0	159.21	0.

gate opening. If the motion were not regular, a graphical solution only could be obtained.

Tables 4 and 5 show the values of h_t obtained by using the formulas in the examples worked out by arithmetic integration in Tables 1, 2, and 3.

It should be noted here, by way of caution, that, in calculating the value of h, the two terms inside the larger brackets of the foregoing formulas are frequently so large and their difference so small as to make it necessary to perform the work by logarithms. The correct result cannot be obtained in such cases by using an ordinary 10-in. slide-rule.

It is now interesting and instructive to compare the results given by the foregoing formulas with those given by other formulas which have been proposed to determine the rise of pressure caused by gradually stopping the flow of water in pipes. For this purpose Fig. 3 has been prepared. There are three such fundamentally different formulas known to the writer, namely, those of L. Allievi,* M. M. Warren,† and H. C. Vensano‡.

The formula by Allievi gives the maximum excess pressure caused by stopping the flow of a column of water, assumed as an incompressible fluid, moving in an inextensible pipe, and neglecting the effect of friction. R. D. Johnson,§ A. H. Gibson,¶ and W. F. Uhl,‖ have each presented a similar formula, with different nomenclature and somewhat differently arranged, but all give the same result as Allievi's formula. Mr. Johnson has also presented a method of determining the pressure-time curve resulting from the same assumption,** and A. H. Gibson has shown how friction may be taken into account by successive calculations.***

The limitations of the Allievi formula are well known to these authors, as they specifically refer to them; they are known, also, no doubt, to many others who use that formula, because it is readily seen that, for zero duration of closure, the formula gives an infinite pressure rise, and this cannot be so because the finite value of maximum water-hammer, for instantaneous closure, has been proved by Professor Joukovsky. Allievi's formula takes into account the effect of the net head on the phenomena that occur during closure. In Fig. 3, there are shown in dotted lines a series of Allievi curves for various heads, and, for the data assumed, these show the maximum rises of pressure as ordinates, and durations of closure as abscissas. For convenience, the time abscissas have been marked off in intervals, instead of seconds. The curves, it will be noted, become very steep as the duration of closure becomes short, and, in the limit, appear

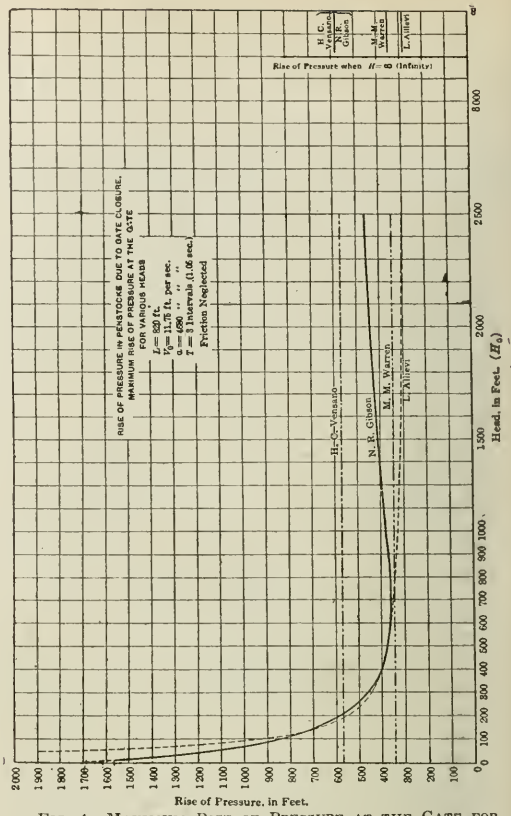
RISE OF PRESSURE IN PENSTOCKS DUE TO GATE CLOSURE.
MAXIMUM RISE OF PRESSURE AT THE GATE
FOR VARIOUS HEADS
L = 820 ft.
V = 11.75 ft. per sec.
g = 32.2
T = Intervals (1.0 sec.)
Friction Neglected
Rise of Pressure when N = ∞ (Infinity)
H. C. Vensano
N. R. Gibson
M. M. Warren
L. Allievi
Rise of Pressure, in Feet.
Head, in Feet. (H0)

FIG. 4—MAXIMUM RISE OF PRESSURE AT THE GATE FOR VARIOUS HEADS

*The writer was unable to obtain an English translation of Mr. Allievi's paper, but his formula is commonly given as follows:—

$$h = NH/2+H(N^2/4+N)^{1/2}$$

where h = rise of pressure, in feet, above normal;
H = normal net head, in feet;
$N = (LV/gTH)^2$;
L = length of penstock, in feet;
V = velocity of water in penstock, in feet per second;
T = duration of gate closure, in seconds;
g = acceleration due to gravity, in feet per second per second.

†"Transactions," Am. Soc. C.E., Vol. LXXIX, pp. 238, 242. Mr. Warren's formula is $h = (LV/g)(T-L/a)$, where a = velocity of the pressure wave, and the other symbols have the same significance as in this paper.

‡"Transactions," Am. Soc. C.E., Vol. LXXIX., pp. 289-299; and Vol. LXXXII., p. 185. Mr. Vensano's formula is: $h = 2LV/gT$ with the limitation that h can never be greater than Va/g.

§"Transactions," Am. Soc. C.E., Vol. LXXIX., pp. 277-281. Mr. Johnson's formula is:

$$H_{max.} = (2MV/N^2)[M+(M^2+N^2)^{1/2}]$$

where H_{max} $M = LV$ = maximum rise of pressure, in feet, above normal; and $N = 2gVT$, in which V is the normal net head in feet, and the other symbols have the same significance as in this paper.

¶"Water Hammer in Hydraulic Pipe Lines," by A. H. Gibson. Mr. Gibson's formula is (in order to prevent confusion with the foregoing, some changes have been made in the nomenclature):

$$p' = (w/g)\{[(L/A)(A_1/T)]^2+(L/A)(A_1/T)[2gH+(LA_1/AT)^2]^{1/2}\}$$

where p' = rise in pressure, in pounds per square foot, behind the valve at the instant where closure is complete, and therefore when p is maximum;
A = cross-sectional area of penstock, in square feet;
A_1 = maximum effective area of valve opening, in square feet;
w = weight of a cubic foot of water;
and the other symbols have the same significance as in this paper.

‖"Transactions," Am. Soc. Mech. Engrs., Paper No. 1354. Mr. Uhl's formula is:

$$DH/H = \tfrac{1}{2}n[n+(n^2+4)^{1/2}]$$

where DH = rise of pressure, in feet, above normal;
$n = LV/gTH$, in which the symbols have the same significance as in this paper.

**"Transactions," Am. Soc. C.E., Vol. LXXIX., pp. 277-281. Mr. Johnson's formulas, to be solved as indicated in his discussion, are:

$$t = T[(x-1)^{1/n}/x^{1/n}]$$

where $x = R\{[H+(y_0)^{1/2}]/[J-(y_0)^{1/2}]\}$,
R being $[J-(Y)^{1/2}]/[H+(Y)^{1/2}]$,
and $n = [(2gT)^2/LV)^2+1]^{1/2}$
$H = [LV/2gT(Y)^{1/2}](n-1)$
$J = [LV/2gT(Y)^{1/2}](n+1)$

***"Water Hammer in Hydraulic Pipe Lines," by A. H. Gibson.

to approach infinity as the duration of closure approaches zero. For low heads Joukovsky's limit of maximum water-hammer is passed by these curves at points of relatively long duration of gate closure. In Fig. 3, a similar series of curves for various heads has been plotted from the result obtained by using the writer's formulas, and these are shown in full lines. It will be noted that these curves show maximum water-hammer for any duration of closure from zero up to one interval $2L/a$, and, as the duration of closure becomes longer, the resulting rise of pressure finally approaches, within certain limits, the value shown by the Allievi curve. For low heads and short durations of closure, the Allievi curves generally show higher values of pressure rise than the writer's; but, for high heads and short durations of closure, they show lower values of pressure rise. This interesting fact will be referred to later when discussing the pressure-time curves.

The formulas of Messrs. Warren and Vensano do not include the net head as a factor, and, therfore, each may be represented, as shown in Fig. 3, by a single curve for all heads. Although these two formulas are objectionable, because they neglect the influence of the net head, it is evident, from the position of the curves representing them in Fig. 3, that under certain special conditions they will give, at least approximately, correct results. These conditions will be referred to later when discussing the pressure-time curves, but it is interesting to note here that Mr. Warren's formula gives approximately the correct results when the net head is such that the excess pressure will be a minimum for any

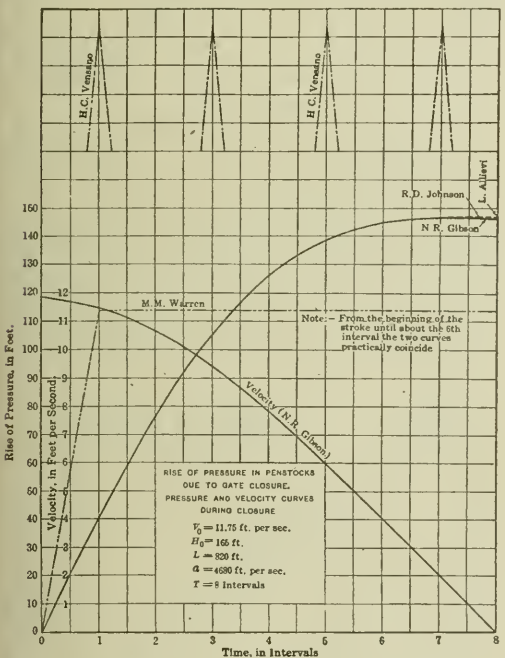
H.C. Vensano
H.C. Vensano
R.D. Johnson
L. Allievi
N.R. Gibson
M.M. Warren
Note:— From the beginning of the stroke until about the 6th interval the two curves practically coincide
Velocity (N.R. Gibson)
RISE OF PRESSURE IN PENSTOCKS DUE TO GATE CLOSURE. PRESSURE AND VELOCITY CURVES DURING CLOSURE
V_0 = 11.75 ft. per sec.
H_0 = 165 ft.
L = 820 ft.
a = 4680 ft. per sec.
T = 8 Intervals
Rise of Pressure, in Feet.
Velocity in Feet per Second
Time, in Intervals

FIG. 5—PRESSURE AND VELOCITY CURVES DURING CLOSURE

given duration of closure. Mr. Vensano's formula gives approximately the correct result when the net head is very high with respect to the velocity destroyed.

Fig. 4 has been drawn to show the manner in which the rise of pressure varies with the net head. The results shown by the curves in Fig. 3 are plotted for a given duration of closure, ordinates representing excess pressure, but abscissas representing net head (H_0). It is thus seen that, for a given duration of closure, the excess pressure becomes less as the head increases, until at a certain value of H_0 the minimum rise of pressure is reached, and, as H_0 continues to increase, the rise of pressure also increases until it reaches a final value, when H_0 is infinite. In the example shown in Fig. 4, L is only 820 ft., and this length would represent the limit of gravity head. The curves, however, have been extended for higher heads, on the assumption, of course, that the head is produced by applied pressure. The corresponding curves obtained from the results of the Allievi, Warren, and Vensano formulas are also clearly shown in Fig. 4.

Pressure-Time Curves

The pressure-time curves, Figs. 5, 6, and 7, show clearly the changes in pressure that take place during the closure

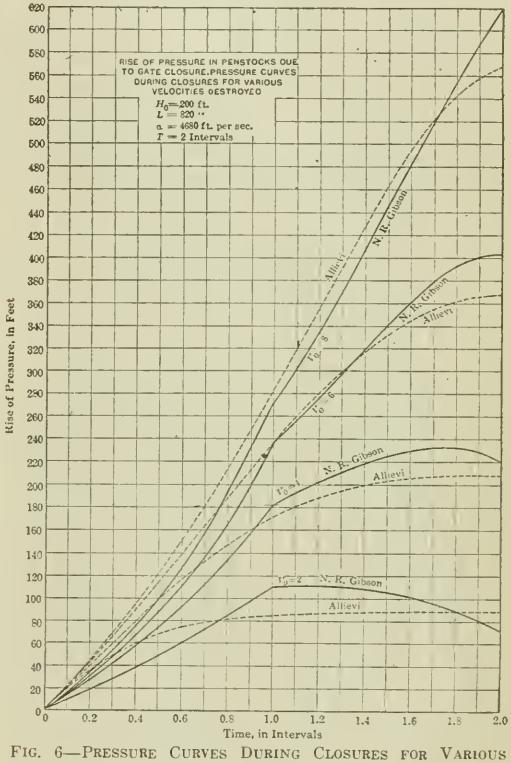
RISE OF PRESSURE IN PENSTOCKS DUE TO GATE CLOSURE. PRESSURE CURVES DURING CLOSURES FOR VARIOUS VELOCITIES DESTROYED
H_0 = 200 ft.
L = 820 "
a = 4680 ft. per sec.
T = 2 Intervals
N.R. Gibson
Allievi
T_0 = 3
T_0 = 2
T_0 = 1
T_0 = ½
Rise of Pressure, in Feet
Time, in Intervals

FIG. 6—PRESSURE CURVES DURING CLOSURES FOR VARIOUS VELOCITIES DESTROYED

of the gates under various typical conditions. The corresponding curves obtained from the formulas of Allievi, Warren, and Vensano have been shown in these figures for the purpose of comparison with those of the writer, and in order that the various results may be studied and explained. In some cases velocity-time curves have also been drawn, in order to show the variable rate of retardation caused by uniform gate closure.

It will be noted first that R. D. Johnson's pressure-time curve, based on Allievi's formula, or indeed Allievi's formula itself, gives the maximum pressure rise always at the end of the closing time. Mr. Warren's curve shows the excess pressure rising uniformly to a maximum at the end of the first interval and then remaining constant until the end of the closing time. Mr. Vensano's curve shows the excess pressure rising uniformly to a maximum at the end of the first interval, falling uniformly to zero at the end of the second interval, and repeating this vibration until the end of the closing time. The writer's pressure-time curves may be similar to any one of these three, depending on the duration of closure and the net head acting on the orifice, or on both of these factors.

Commencing with Fig. 5, it is seen that the pressure-time curve, under the conditions stated, is almost identical with that given by R. D. Johnson, as far as can be detected by the eye. A careful consideration of the writer's formula, however, will reveal the fact that the pressure-time curve obtained from it is not continuous, but is made up of a series of curves, each being one interval long, and cusps or changes of curvature occur at the end of each interval. Under other conditions, the cusps are plainly visible, as, for example, in Figs. 6 and 7. For any finite conditions, these cusps, theoretically, do not disappear, that is to say, the tangent at the end of one interval never exactly equals the tangent at the beginning of the next interval. Furthermore, the slope at the beginning of the writer's curve is never exactly the same as the slope of the Johnson curve. For all practical purposes, however, the pressure-time curves shown in Fig. 5 (and numerous other curves for similar conditions) are almost identical, and the maximum pressure rise occurs in both of them at the end of the stroke. This is interesting because the two theories from which the respective formulas are derived are totally different. When the conditions are such as to produce practically identical pressure-time curves similar to the foregoing, it indicates that the effect of the compressibility of water, the elasticity of the pipe walls, and the resulting harmonic vibrations in the water column may be neglected, and in such cases the assumptions, on which the Allievi formula has been based, are practically sufficient.

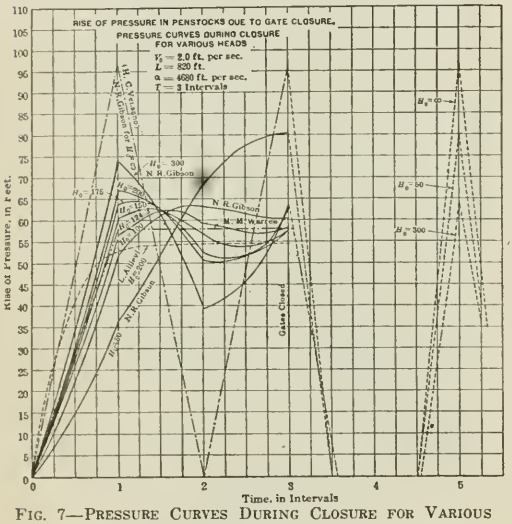

FIG. 7—PRESSURE CURVES DURING CLOSURE FOR VARIOUS HEADS

The results obtained from the Warren and Vensano curves are much at variance with the foregoing, as indicated in Fig. 5, and the writer is of the opinion that neither of these formulas can apply for all values of H_0, and, only under certain conditions, which will be mentioned later, are they approximately correct.

As shown in Fig. 3, the maximum pressure rise given by the writer's formulas, as would be expected, is nearly always less than that given by the Allievi formula when the duration of closure is short and when H_0/V, the ratio of head to velocity destroyed, is small. When the ratio of head to velocity destroyed is large, the reverse is the case, and, when H_0 becomes infinitely large, the writer's formulas agree with that of Mr. Vensano and give results twice as great as Allievi's formula for any finite duration of closure greater than one interval. Even when the values of maximum pressure-rise, as given by the Allievi formula, are in close agreement with those of the writer, both for short and long durations of closure, the respective shapes of the pressure-time curves may be different. Figs. 6 and 7 show clearly the characteristics of the pressure-time curves in a number of typical cases, and a close study of them, together with Fig. 4, will make clear the relation that exists between the rise of pressure and the net head for any velocity destroyed. The shapes of the pressure waves that continue after the gates have been closed, until damped out by friction, are also indicated in Figs. 2 and 7. (See last week's issue for Fig. 2).

Referring now to Fig. 7, it will be noted that the particular case when Mr. Warren's formula gives approximately correct results is when the head is such that the rise of pressure due to gate closure is a minimum for the particular velocity destroyed. This occurs when $H = (3/7)(aV/g)$.

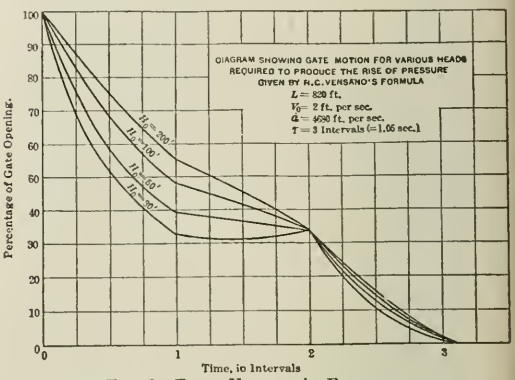
DIAGRAM SHOWING GATE MOTION FOR VARIOUS HEADS REQUIRED TO PRODUCE THE RISE OF PRESSURE GIVEN BY R.C. VENSANO'S FORMULA
L = 820 ft.
V_0 = 2 ft. per sec.
a = 4680 ft. per sec.
T = 3 Intervals (= 1.05 sec.)
H_0 = 200'
H_0 = 100'
H_0 = 50'
H_0 = 30'
Percentage of Gate Opening.
Time, in Intervals

FIG. 8—FROM VENSANO'S FORMULA

Fig. 7 shows, also, the shapes of the pressure-time curves for various heads, and indicates the variation in time when the maximum pressure occurs during closure.

The foregoing examples, except Tables 2 and 5, have all been calculated for uniform gate motion. As the writer's formulas may be applied for any variable rate of gate motion, it is interesting to determine the nature of the gate motion for various heads that would be required to produce diagrams similar to those proposed by Messrs. Warren and Vensano. A diagram of the shape proposed by Mr. Warren may be produced by the simple expedient of increasing the speed of gate travel at the end of the first interval to double the rate of its motion during the first interval and maintaining this double rate until the end of the stroke. Such an operation, though giving the same shape to the pressure-time diagram, will not, of course, give the same rise of pressure as for the same duration of uniform closure, but the latter is given by a gate motion similar to that shown in Fig. 9. If a pressure-time diagram of the same shape as

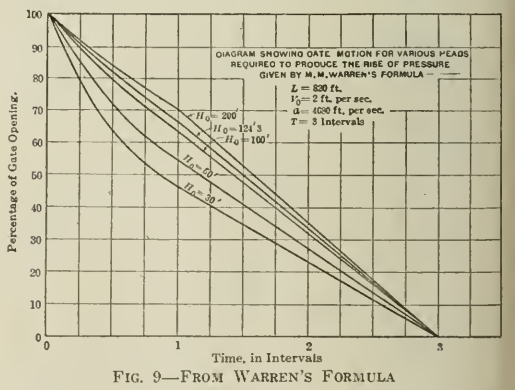
DIAGRAM SHOWING GATE MOTION FOR VARIOUS HEADS REQUIRED TO PRODUCE THE RISE OF PRESSURE GIVEN BY M. M. WARREN'S FORMULA
L = 820 ft.
V_0 = 2 ft. per sec.
a = 4680 ft. per sec.
T = 3 Intervals
H_0 = 200'
H_0 = 124'3
H_0 = 100'
H_0 = 50'
H_0 = 30'
Percentage of Gate Opening.
Time, in Intervals

FIG. 9—FROM WARREN'S FORMULA

Mr. Vensano's is desired for a low head, a very complicated gate motion would be required, such, for example, as that shown in Fig. 8. In a similar manner, the gate motion required to produce any suggested form of pressure-time curve may be determined.

The manner in which excess pressures vary from gate to origin has been explained in Miss Simin's translation of Professor Joukovsky's paper, although therein worked out on the erroneous assumption of uniform retardation of the velocity of the water flowing in the pipe.

O. V. Kruse, who was associated with the writer at the time this paper was first written, has made an original study of the variation in excess pressure from gate to origin, based on the writer's application of Joukovsky's theory to slow-closing gates. The results of this study prove that when the duration of uniform closure is less than $2L/a$ the maximum pressure is exerted along the pipe to a point where the distance to the origin is equal to $Ta/2$. From that point to the origin the pressure reduces uniformly to zero. When the duration of uniform closure is equal to, or greater than, $2L/c$, the maximum rise of pressure occurs at the gate, and from there to the forebay or origin reduces to zero, uniformly along the length of the pipe.

Fall in Pressure

Professor Joukovsky's theory of pressure waves applies also to the fall in pressure produced by opening a valve or gate at the end of a pipe line, and the application of his theory to the case when a valve is gradually opened may be made in a similar manner to the foregoing. It is obvious, of course, that the fall in pressure caused by opening a valve in a certain time is not precisely the same as the rise in pressure caused by closing the valve in the same time, because the rate of acceleration cannot be the same as the rate of retardation. It would lengthen this paper unduly, however, to do more than state here that the formulas for fall in pressure may be obtained in a similar manner to those given herein, the principles being the same in both cases.

Experimental Results

The writer has not yet had an opportunity of testing the formulas presented in this paper by experiments, to show, not only the correctness of the values of maximum pressure rise, but also the shapes of the pressure-time curves under various conditions. It is expected, however, that an opportunity of doing so may possibly occur in the not too distant future. In the meantime this paper is presented in the hope that it will receive criticism or confirmation from those interested in the subject.

The experimental results obtained by Mr. Vensano, and presented in his paper entitled "Pulsations in Pipe Lines," give some striking confirmation of the correctness of the writer's formulas, not only as regards the maximum pressure rise, but also as indicating the resemblance between the calculated and observed pressure-time curves, both before and after the gate was completely closed, and at various points along the pipe line, as well as at the gate.* These, however, were carried out under a very high head (1,260 ft.), and could hardly be accepted as a general proof.

The writer also proposes to show how the pressure-time diagram may be used to determine the velocity of flow in a pipe, for the purpose of measuring the rate of discharge previous to the closing of the gate. This will be made the subject of another paper to be written at a future time.

In conclusion, the writer desires to accord credit to O. V. Kruse for the valuable help he has given in the preparation of this paper, to R. L. Hearn for the work of preparing Figs. 8 and 9, and to R. D. Johnson for the many helpful suggestions he has kindly made.

*See discussion by Norman R. Gibson in *Transactions*, Am. Soc. C. E., Vol. LXXXII., p. 236.

Jeffrey Mfg. Co., of Montreal, P.Q., and Columbus, Ohio, have opened a new branch office in Detroit, Mich., in charge of O. B. Westcott, who for many years past has been in the company's sales, engineering and construction departments.

RENSSELAER VALVE CO. APPOINTS AGENTS

ANNOUNCEMENT has been made by Irving A. Rowe, general manager of the Rensselaer Valve Co., Troy, N.Y., that he has appointed the General Supply Co. of Canada, Ltd., as sole representative for the Dominion of Canada with the exception of the city of Winnipeg and the province of British Columbia. For these two territories Mr. Rowe is under contract with other representatives.

The General Supply Co. has been rapidly building up a very strong water works department. Following are some of the firms it is now representing:—

Wallace & Tiernan Co., Inc., who are manufacturing an apparatus for controlling chlorine gas for treating water and sewage.

Electro-Bleaching Gas Co., who manufacture liquid chlorine.

Pitometer Co., makers of all types of instruments, recording and otherwise, operating on the pitot principle. This firm also makes complete water works surveys for detecting any leaks or excessive use of water on city supplies.

Pittsburgh Filter & Engineering Co., manufacturers of all types of filters and controlling apparatus.

Builders' Iron Foundry, who manufacture venturi tubes and recording devices, and special equipment for controlling and recording flows of any nature.

National Water Main Cleaning Co., who have perfected a mechanical apparatus for removing all deposits and encrustations of any nature from the interior surface of pipe lines.

The head office of the General Supply Co. is located at Ottawa, with G. B. Greene as general manager. The company has branches in Montreal, Toronto, Winnipeg and Vancouver. Among the technical staff in its water works department are J. Van Benschoten, formerly engineer with the Wallace & Tiernan Co.; R. L. Haycock, formerly water works engineer of Ottawa and superintendent of transportation with the Algoma Steel Corporation, Sault Ste. Marie; A. G. Wilkins, an engineering graduate of McGill University; and C. Laurendeau, an engineering graduate of Laval University, Montreal.

The Rensselaer Valve Co. manufactures gate valves for all pressures and types of operation and control, check valves, bronze valves, valve indicators, indicator posts, floor stands, valve boxes, air valves and Corey-type fire hydrants. The Rensselaer factory is in Cohoes, near Troy, N.Y., with sales branches in New York, Pittsburgh, Chicago and Louisville. The firm was established in 1853.

New materials for use as concrete aggregates (such as iron-ore tailings, graphite tailings and garnet tailings) are being investigated by Sub-Committee No. 7 of the Committee on Concrete and Concrete Aggregates, American Society for Testing Materials. H. S. Mattimore is chairman of the Sub-Committee.

The Canadian Engineering Standards Association has formed committees dealing with wire rope, steel bridges and their construction, rails and track, electrical work and aircraft parts, with a view to obtaining an agreement of Canadian specifications or standards that will be acceptable to nearly all concerned. In this work consideration will first be given to existing specifications or standards that have proved satisfactory in this country, Great Britain or the United States.

Lord Kelvin, lecturing to his class in Glasgow University, getting his eye on a student whose thoughts were evidently far from the class-room, pounced on this man and asked, "Will you please tell me what electricity is?" The startled student stammered and replied, "Please, sir, I have forgotten." Kelvin then turned to his class and said, "Gentlemen, behold this sad spectacle. The only man that ever knew what electricity is, has forgotten."—From an address to the London Rotary Club delivered by E. V. Buchanan, general manager of the Public Utilities Commission, London, Ont.

ROAD DRAINAGE AND FOUNDATIONS*

By Geo. Hogarth
Chief Engineer, Ontario Department of Highways

IN building any roadway, whether for light or heavy traffic, two of the most important points to be considered are drainage and foundations.

The stability of the entire road surface depends upon the foundation and the strength and life of the foundation largely depends upon the facilities provided for drainage. While proper attention may be given to the drainage of the surface of the road by giving the roadway sufficient crown to shed the water, the great importance of subsurface drainage may be entirely overlooked. There are, therefore, surface and subsurface methods of drainage and the very great importance of each must be realized and used to the fullest extent if we desire a permanent foundation. A sound and enduring foundation cannot be secured on subsoil saturated with water, but a good foundation can be secured by the simple means of keeping the subsoil dry. If water is not excluded from the foundation it will sooner or later destroy the road surfacing, since no road ever built could escape destruction should the foundation become yielding and soft.

Earth Loses Sustaining Power

The ordinary clays and earths form a naturally strong foundation when dry, but where the ground is wet and springy a good road cannot be constructed without proper subdrainage since when wet the earth loses its sustaining power and the surface formation goes to pieces. Where the subsoil is gravelly, underdrains will usually not be required, but where it is sandy, give close attention to the damp or wet spots and provide ample subdrainage.

It may be said that the whole problem of improvement and maintenance of ordinary country roads is one of drainage. Upon earth roads drainage is especially important because the material of the road surface is very susceptible to the action of water and so, more readily destroyed than are the surfaces of the better class of roads. An undrained earth road offers a splendid opportunity to the frost, and a spring thaw may result in such a road being impassable for days or weeks. A road on a wet undrained bottom will always be troublesome and expensive to maintain, and it will be economical in the long run to go to considerable expense in making the drainage of the subsoil as perfect as possible.

There are three systems of drainage, namely: Underdrainage, side ditches and surface drainage, and the objects of each will be stated.

Underdrainage will lower the water level in the soil and keep it at a safe distance from the foundations. This aids the action of the sun and wind, which tend to dry the surface of the road, but if the foundation, due to lack of underdrainage, is soft and spongy, the road will soon become a mass of mud.

Underdrainage dries the ground quickly during the spring when otherwise a saturated condition of the soil would exist.

Underdrainage intercepts the subsurface flow of water beneath the crust of the road.

Reduce Heaving and Cracking

In many cases it will be noticed that though the ground is dry, when it freezes in the fall, it is very wet and soggy in the spring when the frost comes out. The reason for this condition is that after the ground freezes, water rises slowly in the soil and if it is not drawn off by underdrainage it saturates the subsoil and rises further as the frost goes out. Underdrainage not only removes the water but reduces and will in many cases prevent the destructive heaving effects of frost.

The heaving and cracking of pavements may be entirely attributed to the freezing of water in the subgrade under the pavement. Underdrainage will greatly lessen the damage done in this way by the frost, but entirely to prevent such destructive action may be very difficult. It may be said that when underdraining a section of road known to have a wet subgrade it is well to provide a liberal number of drains. Too many cannot be laid. Particular attention to the underdrainage should be given at points on the road from 50 to 200 feet or more down grade from the top of a hill or slope and particularly so if the roadway is in excavation. Water will usually filter out to the surface at such points and the entire skill of the roadbuilder will have to be exercised in locating subdrainage to prevent heaving and cracking. In all such cases do not curtail the underdrainage, but rather put in every foot of tile that can be placed.

Wherever underdrainage is provided be careful to provide proper grade and good outlet for the tile since poor results will come from tile that are indifferently laid and improperly vented.

Tile drains furnish the usual means for subdrainage, but in some cases a blind drain may be used to good advantage. The construction of a blind drain is accomplished by opening a trench several feet deep along or across the road and afterwards filling the trench with stone. The depth, distance apart and location of such trenches will depend entirely upon the conditions encountered and the result desired. Careful attention to the subdrainage of the road if of great importance and money spent for such work is always a splendid investment.

Side ditches for all country roads are essential. Their object is to receive the water from the surface of the travelled roadway and the grade of the ditch should be such that the water is carried rapidly to a good outlet. Such ditches also intercept and carry away water that would otherwise flow from the side hills upon the road. Side ditches need not be very deep; a depth of 2½ or 3½ feet below the crown of the roadways will usually be found sufficient and the sides should be given a slope flat enough to prevent caving. In order to be effective, ditches should have as great a grade as possible, they should be well cleaned out and have free outlet in some creek or stream.

Surface drainage of the traveled portion of the road affects mainly the maintenance of the road and is accomplished by giving the road or pavement surface a crown which tends to shed the water to the side ditches. The slope of the crown should be sufficient to carry the water freely and quickly to the side ditch. The proper crown to use will vary with the nature of the roadway; when a good surface is maintained, a moderate rise will be found sufficient. For earth, clay or gravel roads a usual crown is one inch per foot, while for bituminous or concrete pavements ½ or ¼ of an inch per foot is ample.

Foundations

While drainage is undoubtedly one of the first essentials of good highways, the foundation of a road is also of great importance and one of the first substantial advances in road building was made when the laying of a course of stone for the base of a road was adopted.

The foundation of a road should normally last a number of years while the cost of maintenance should be for replacing and renewing the worn out surface. Such conditions are difficult to obtain since the foundation of 4 inches of crushed stone to-day may be entirely inadequate to-morrow under more severe traffic. The heavy loads using highways to-day require an abundance of material in the foundation of the roads and if our work is to be enduring we must see to it that strong and sound foundations are provided.

Frequently the taxpayer may enquire as to why so much material is required in a road and a demand will be made for more surface with a smaller amount of stone hidden in the foundation. Such an enquiry loses weight when the same ratepayer states that a concrete road 6 inches thick is too heavy and his idea of a concrete road is a surface of concrete about an inch thick spread over the entire space between the fences.

Roads built only a few years ago are in many cases in poor condition or destroyed to-day because a shallow, weak foundation was provided. Improved roads naturally draw traffic and people will go many miles out of their way in order to travel over a section of good road. This fact should be

*Paper presented to the Canadian Good Roads Association.

given full consideration in designing a road and any traffic census made prior to reconstruction should be considerably increased in order to estimate the travel on the improved surface. A road is not rebuilt to provide only for present traffic but it is rebuilt to carry present traffic together with whatever vehicles may use it when improved and in some cases it may be found that the traffic on an improved road immediately after reconstruction is ten or more times the original number of vehicles using the road.

Soil Determines Foundation Depth

The strength of the foundation of a road is greatly affected by the supporting power of the different soils and in order to obtain a road surface having a uniform resistance, the thickness of the crust will need to be varied. A greater depth of foundation will be required on soft clay than on gravel and for soils of intermediate strength a varying thickness will be required. Soils of poor supporting power will carry safely a load of about 600 pounds per square foot while gravel subsoil is safe under a loading of about 3,000 pounds per square foot.

Many kinds of foundation courses are available in the construction of roads, such as crushed stone, screened gravel, pit gravel, field stone, quarry stone or Telford. Before placing a foundation course the subgrade should be properly rolled in order to solidify the surface and prevent the material of the foundation being forced into the soil. This point is as important with a gravel road as it is with more permanent types of construction. A smaller amount of crushed stone or gravel will be required to build the foundation of a road on a consolidated subgrade and the rolling and compacting of the subgrade before placing the foundation is therefore an economy. A compacted subgrade also enables the foundation of the road to better withstand the effects of heavy traffic, whereas a soft and yielding subgrade tends to cause a sinkage of the foundation with consequent hollows and holes in the road.

Crushed stone where used as a foundation for a macadam road should be not less than 6 inches in thickness when compacted and the size stone will usually be about that passing a 2½ inch ring.

Screened gravel of 1 inch to 3 inch size may be used in place of crushed stone and when placed in the road a filler containing some clay or loam should be spread in order to thoroughly consolidate the stones.

Such gravel does not interlock as crushed stone does and a thicker foundation course of gravel is therefore required.

Field Stone and Telford

Field stone used for a foundation may be laid in one course from 6 inches to 12 inches in depth and the inequalities between the stones filled with coarse gravel or crushed stone. The depth of the course should in all cases be suited to the average size of field stone available as it is not economical to break them to a definite size. A variation of an inch or so in the size of the stone is of no consequence since the surface stone will serve to even up all inequalities.

The Telford base may be composed of quarry stone which has been broken to size with a stone hammer. Such foundations have given good satisfaction when used but the cost of hand placing the stones seems to have outweighed the advantages of this type of construction.

In conclusion it may be said that the adequate drainage of a road is the first requisite to permanence and if we add to proper drainage a sound foundation, the cost of maintaining the surface of the road will be greatly lessened. Drainage and foundations are two very essential details of road construction and close attention to these points when designing and constructing a road will lead to better, more durable and more satisfactory roads.

The Minister of Labor has created a Board of Conciliation to deal with the dispute between the Bedford Construction Co. of St. John, N.B., and its employees engaged on the Courtney Bay construction work. Sir Ezekiel McLeod will act as chairman, and Brig.-Gen. C. L. Hervey, of Montreal, will represent the company, and J. E. Tighe the employees.

COST-PLUS-FIXED-FEE CONTRACT

Building Construction a Huge Gamble Except Under This Form of Agreement—Co-operation for a Better Building, Plus Greater Speed and Security

By A. E. Wells
President, Wells Bros. Construction Co.

IF a half dozen street urchins are caught by a burly representative of the law while engaged in the pastime of shooting craps, the law against gambling acts. Lawmakers have recognized that gambling is an unnecessary evil and have, so far as possible, put a stop to it. Yet an owner and a contractor can gamble with a million times the stake of the street urchins without fear of the law, and it is done constantly under the guise of the lump-sum contract.

Under its terms the contractor agrees that for a certain sum of money he will guarantee the owner against all the unknown conditions involved in putting up a structure. Whether he makes his figured profit or whether he loses so heavily as to be put out of business rests partly on his ability to figure costs, but largely on his luck in failing to meet those conditions which would increase costs.

Both parties to this contract stand to gain or lose. If the job costs 20% more than estimated, the owner gains to the other's loss. If conditions make considerable saving possible, then the contractor gains to the owner's loss.

Should Contractor Guarantee Cost?

Many contractors who in times past have built extensively in your field are no longer operating. Others have taken their place. Perhaps the majority of the missing firms are those who were expected not only to build according to specifications and within the time limit, but to gamble that their costs would fall within a fixed contract price. Gambling against variables such as the forces of nature and the conditions of labor—they lost. In many cases their failure involved an added investment on the part of the owner or possibly the surety company. No one gained.

The contractor is an expert retained to assemble certain materials into a finished structure. The question being asked to-day is, "Should the contractor insure the owner that his structure will not exceed a definite contract price?"

In competitive bidding the cost of this insurance is paid generally by the low bidder out of profits or, as frequently happens, out of his capital, for the reason that he is more likely to get the contract as he scales down his allowance for contingencies. In fact the man whose bid includes a safe allowance for insurance against higher costs cannot expect to obtain work under the competitive bidding system. The inevitable result is the bankruptcy of many contractors and an additional cost to the owner or the surety company to complete the unfinished contract. This situation has come to such a point that surety companies are refusing to write surety bonds on fixed-price contracts except under specially favorable conditions, and frequently recommend to owners the cost-plus-a-fixed-fee contract.

Reliable Estimate More Valuable

But from the owner's standpoint is it not preferable to know in advance what a certain project will cost? It is true that a careful estimate is due him. It should be made by a reliable contractor and checked by owner's architect and engineer. Such a figure should be more satisfactory than a competitive bid which does not necessarily show the cost of the building but only what some contractor is willing to gamble is the cost of the job.

An issue of bonds for an office building or other structure can as well be based upon a careful preliminary estimate in either case. It can only run below the estimate under the cost-plus-fixed-fee plan. Is not the owner entitled to the possible saving?

Additional financing may be an unfortunate necessity, but is there reason why the contractor should be asked to under-write the accident of greater cost?

At the Chicago meeting of the Associated General Contractors of America, this topic was discussed and Brig.-Gen. R. C. Marshall, Jr., chief of the construction division of the U.S. War Department, pointed out the fault of the usual pre-war basis of contract. He showed the impossibility on recent war work of asking for competitive bids, because speed was the essence and detailed plans and specifications were never complete at the time when construction had to start.

On such work it was, therefore, out of the question for a contractor to bid on a flat contract price basis. It would not have been fair to either side. As a result, there was developed a form of contract known as the cost-plus-sliding-scale-fee contract.

Gen. Marshall said that early in the spring of 1918, the program of work before the construction division was so extensive that it seemed advisable to have the merits of this form of contract again passed upon, and a committee of eminent business men unqualifiedly endorsed this form of contract. In Gen. Marshall's own words at the convention of general contractors:—

"Unjust, Inequitable and Uneconomic"

"No contractor should be called upon nor permitted to undertake the performance of any contract that within the four corners of the paper upon which it appears is, or may be, written the financial bankruptcy of the contractor. It is unjust, it is inequitable, it is uneconomic. The great lesson of this war on the subject of the relationship between the contractor and the owner is the cost-plus contract. This represents the only equitable basis under which a contractor may perform constructive and economic services for the owner. It is the only form of contract which affords protection to both parties. To me all the energies, the thought and the experience of this country within its own continental lines during the past year and one-half of this world struggle, shall have been in vain unless out of it shall grow, as a permanent institution, solidifying the economic relationship between the contractor and the owner, the cost-plus contract."

We have been operating under this plan almost exclusively for several years. We know that it is possible to convince most business men of the perfect fairness of the cost-plus contract, and among our clients are several who would be the last to tie themselves up with us on any basis of contract likely to be unfair or dangerous. We have built on this basis for the Robert Simpson Co., Ltd., Toronto, five separate buildings; for the William Davies Co., Ltd., Toronto, six buildings; and for Montgomery, Ward & Co., four successive times.

For these firms we have been able to start actual construction much earlier than otherwise would have been possible, which means early occupancy. The reason for this is that we can start the foundations just as quickly as the foundation plans are complete, and further design and construction may go on coincidently.

Complete Plans Not Necessary

Money tied up during construction earns nothing until the building is ready for occupancy, and the interest often amounts to a considerable sum. When we have opportunity to work with the owner, engineer and architect from the very inception of the plans, and when we begin foundations as soon as the general contour of the building and equipment are determined upon, we are able materially to cut down the period during which the owner's capital is unproductive. Under the lump-sum contract it is necessary that the plans be complete before bids are taken, which may delay occupancy for months, and without occupancy a building investment is poor as a dividend producer.

But, while speed is of first importance in most building contracts, yet fairness to both parties is an equally good reason for the general adoption of the cost-plus contract, and on that basis our company is now operating almost exclusively.

Unquestionably the contractor is called in because he is an expert in building, and not to absorb the risk entailed in the lump-sum contract. If it is not the purpose of the owner to buy price insurance along with his building, then cost-plus-fixed-fee is a better basis.

BRITISH ENGINEERING STANDARDS REPORTS

(Concluded from page 294)

Report No. 71-1917. *Report on British Standard Dimensions of Wheel Rims and Tire Bands for Solid Rubber Tires for Automobiles.*—This report gives standard sizes of wheel rims and corresponding internal dimensions of solid rubber tires, for sizes of wheel varying from 670 mm. to 881 mm. Metric dimensions are used throughout.

Report No. 72-1917. Revised September, 1917. *British Standard Rules for Electrical Machinery* (excluding motors for traction purposes).—This important report is intended to define the conditions which characterize British standard electrical machinery, including transformers but excluding traction motors, and to provide the purchaser and manufacturer with a general specification indicating the information which should be forwarded with an enquiry or an order for an electrical machine. Methods of defining the rating or rated output are formulated, and in this connection are in substantial agreement with the corresponding rules of the American Institute of Electrical Engineers. Enquiries based on these rules will enable the purchaser to compare tenders received from various manufacturers.

Report No. 74-1917. Revised September, 1917. *British Standard Specification for Charging Plug and Socket for Vehicles Propelled by Electric Secondary Batteries.*—This report contains the provisions necessary to secure interchangeability between any charging plug and any socket of the concentric type. Dimensions of the contact portion of the plug and socket, and dimensions of the gauges needed to check these are given.

Report No. 75-1916. *British Standard Specifications for Wrought Steel for Automobiles.*—This important report contains definitions of terms used, methods of testing, and specifications for ten grades of carbon, nickel and nickel-chrome steel, each specification giving chemical composition, tensile and brinell tests.

Report No. 76-1916. *British Standard Nomenclature of Tars, Pitches, Bitumens and Asphalts Used for Road Purposes and British Standard Specification for Tar and Pitch for Road Purposes.*—This valuable report defines tars, pitches, bitumens, and asphalts for road purposes, distinguishing between the tar products and bitumens and asphalts. In this respect the practice of the B.E.S.A. is not in accordance with that usual in the United States, where the term bituminous is applied in a wider sense than in Great Britain. The specification gives definitions, properties and methods of testing for two qualities of tar, and for pitch suitable for pitch-grouting.

Report No. 82-1919. *British Standard Specification for Starters for Electric Motors* (face-plate type).—This report covers definitions, pressures, methods of enclosure, standard sizes and ratings, general construction, marking and tests

Report No. 84-1918. *Report on British Standard Fine (B.S.F.) Screw Threads and Their Tolerances.*—This report gives revised tables of dimensions for British standard fine screw threads and covers theoretical dimensions and standard sizes and tolerances of bolts and nuts for two grades of fit. The report also contains an appendix dealing with methods of determining and compensating for errors in pitch, form of thread and diameter. Much information is given regarding methods of gauging screw threads.

Report No. 88-1919. *British Standard Specification for Electric Cut-Outs for Low Pressure, Type O.*—This specification covers dimensions and standard sizes of cut-outs for low pressure and ordinary duty. A separate specification is contemplated for heavy-duty cut-outs.

Report No. CL3,750. *Interim Memorandum on French Metric Screw Threads for Aircraft Purposes.*—This memorandum describes the system of screw threads for aircraft purposes used by the French military authorities, and is accompanied by tables showing limits of size, tolerances, etc., for two grades of fit. The form of thread is that of the Systeme Internationale, in which the crest is cylindrical while the root of the thread is curved in section. The finer tolerances are provided for cases where great accuracy is required. The second grade tolerances are suitable for ordinary bolts and nuts.

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ESTABLISH AN "INTERESTING CORNER"

ONE of Cleveland's leading financial institutions, the Cleveland Trust Co., whose building is at a very prominent corner in the business section of that city, has offered the use of a space adjoining its head-office building, for exhibitions of machinery and other products of Cleveland factories. The idea conceived by the Cleveland Trust Co. will prove of interest to many other municipalities where exhibitions of products manufactured locally will be of educative value and will also arouse civic pride and add to local knowledge of civic affairs. The more that citizens know of the products that are manufactured within their own town, the more likely are they to be boosters for their own municipality and to realize better its advantages for themselves and their children.

The corner which the Cleveland Trust Co. devotes to these exhibits is semi-circular, slightly above the sidewalk level, and enclosed with a low but heavy ornamental metal arilink. Each firm is allowed to continue its exhibit for a week, and there is no charge for the space. Exhibits are booked in the order in which applications for the space are made to the trust company.

The public has taken so keen an interest in these demonstrations that the spot has been popularly named "Cleveland's Most Interesting Corner." At this corner the public can obtain a close view of the operations and processes entering into the manufacture of all their home products. The exhibitions are much like those interesting ones in the Process Building at the Canadian National Exhibition, which annually proves one of the strongest attractions of that great show.

The Canadian Manufacturers' Association is spending large sums of money in advertising to the Canadian people that they should buy Canadian-made goods and so reduce our adverse trade balance. To assist this advertising campaign, one of these interesting corners should be established in every city throughout the Dominion. They would show the people, by practical demonstrations, the care and accuracy with which Canadian products are prepared, and the quality of the materials used in their manufacture. Not only would these exhibits be of benefit in increasing the sales of Canadian goods, but they would also add greatly to the knowledge possessed by Canadians of Canada's resources and manufactures.

CLASSIFICATION OF E.I.C. MEMBERS

AT present the Engineering Institute of Canada is composed of honorary members, members, associate members, juniors, students and associates. The council of the Institute might advantageously consider an amendment to the constitution and by-laws, changing the title of "member" to "fellow," and of "associate member" to "member." Should the vote favor such an amendment, the Institute would then consist of honorary members, fellows, members, juniors, students and associates.

The advantages of these changes in titles are several. One of the most important is the abolition of the misleading and inaccurate title, "associate member." The general public, and all excepting those thoroughly conversant with the Institute's affairs, are likely to think that an associate member is one who is merely associated with the Institute, and who is not an active member. As is well known within the profession, an associate member is just as much a corporate member of the Institute as is a member, but a layman is not likely to grasp the full significance of the classification, and as a result the associate members are unquestionably suffering in professional status.

We believe that the classification of "fellow" would be popular among the present "members." The word "fellow" in all scientific societies is a mark of distinction and eminence. The public are familiar with the term and are accustomed to respect it. They know that in connection with many other societies, fellowship is the highest grade of membership obtainable. There is something about the title that resembles a technical degree. A "Fellow of the Engineering Institute" would more readily obtain public respect than a "Member of the Engineering Institute." The public has always associated "fellow" with distinguished and learned men, excepting when used as a slang term. The title, "member," is so common in connection with so many different societies of a general nature for which the only entrance qualification is an annual fee, that it carries no distinction whatever. Many laymen do not realize the vast difference between being a member of a Board of Trade, for example, and being a member of the Engineering Institute of Canada. But church, political and other societies include no fellowships; the term, "fellow," is reserved by almost universal consent for learned members of respected scientific and professional societies.

There are many associate members of the Institute who could readily qualify as members but who have never applied for the transfer because the annual fees for members are heavier than for associate members. The attraction of the title, "fellow," would undoubtedly induce scores of these men to apply for transfer, and in this way the funds of the Institute could be considerably augmented in an entirely legitimate manner.

If the rather long abbreviation "A.M.E.I.C." could be abolished, there would be more uniformity in the abbreviations indicating the different degrees of membership within the Institute. F.E.I.C., M.E.I.C., J.E.I.C., S.E.I.C., and A.E.I.C. would be readily recognized as the abbreviations respectively for fellow, member, junior, student and associate.

Another advantage would be the avoidance of confusion in regard to "associate members" and "associates," another point of difference which the public does not grasp and concerning which apparently the members of the Institute themselves are often careless. Return post cards have often been mailed to members of the Engineering Institute, on

which the members were supposed to write their name and the rank held in the Institute, the cards being required for branch purposes or other official work. Many associate members merely write the word "associate" after their name. On the other hand, we have knows instances where one's statement that he was an associate of the Institute was understood to mean that the speaker was an associate member, although no such meaning was intended or implied. There is a wide distinction between the requirements for membership in the two classes, but there is entirely insufficient distinction between the two titles, in all fairness to the associate members.

The classifications above suggested, including fellows and members, but containing no associate members, is the classification that was adopted some time ago by the American Institute of Electrical Engineers, and which apparently is giving excellent satisfaction among the members of that very strong organization.

The necessary amendment to the constitution and by-laws is so simple that it would not cause any confusion. It would merely be necessary to substitute the word "fellow" wherever the word "member" now appears, and the word "member" wherever the words "associate member" now appear.

PERSONALS

SIDNEY APPLETON has entered private practice in Toronto in partnership with Willard Chipman, the firm to be known as Appleton & Chipman, with offices at 58 Wellington St. East. Mr. Appleton was born January 10th, 1883, in London, Eng., and is a graduate of the East London Technical College, subsequently spending two years in an engineering course at London University. Prior to his technical education, he spent three years as an apprentice machinist, fitter and erector, and one year as a switch board operator at the Ilford Municipal Electric plant. After three years at sea as a marine engineer, Mr. Appleton was engaged for six years with R. & H. Green & Silley Weir, Ltd., as chief draftsman and manager of the Royal Albert Dock Works, London, in full charge of ship repairs. He resigned that position to become chief engineer of Trinidad Oil Fields, Ltd., in the British West Indies, where he was in charge of railway, jetty and building construction, pipe lines, power plant and all field engineering work. After one year in Trinidad, Mr. Appleton came to Canada and became town engineer of Camrose, Alta., which position he occupied for two years, resigning to become shop superintendent of the Dominion Cartridge Co., who were then engaged on war contracts, and with whom he spent two years. In June, 1917, he left the Dominion Cartridge Co. to became assistant chief engineer of the marine engine department of the Imperial Munitions Board, Ottawa, where he was in charge of the drawing office in which designs were made for use by the various shipbuilders. He requisitioned all the necessary material for the construction of the ships, and was in charge of the production of same, having under him for that purpose a large staff of executives, engineers and clerks. Mr. Appleton is an asociate member of the Institution of Mechanical Engineers of Great Britain.

J. N. FINLAYSON, professor of civil engineering, Dalhousie University, has been appointed professor of civil engineering at the University of Manitoba.

A. B. CLARSON has resigned as general secretary of the Association of Canadian Building and Construction Industries. Mr. Clarson was formerly city engineer of Verdun, P.Q. J. C. Reilly has been appointed as acting secretary, with temporary quarters at 65 Victoria St., Montreal.

W. H. TAYLOR, who has been on the staff of Frank Barber, consulting engineer, Toronto, for the past twelve years, has resigned in order to undertake water works and sewer contracting on his own account.

MAJOR N. M. HALL has been appointed lecturer in civil engineering at the University of Manitoba. Major Hall graduated in 1907 at McGill University. Until he enlisted in the Royal Engineers in 1915, he was engaged with the Western Canada Power Co. and with Ducane, Dutcher & Co., consulting engineers, Vancouver.

J. PENROSE ANGLIN, of Montreal, president of the Association of Canadian Building and Construction Industries, has just perfected the merger of the Anglin and Norcross companies, which was announced some time ago, and last week made a public issue of preferred stock in the new concern, Anglin-Norcross, Ltd. Mr. Anglin has been elected president of the merged companies.

L. P. BURNS, who recently purchased all the outstanding interests in the firm of Burns & Roberts, Ltd., Toronto, announces a change in the firm name. This company will be known in the future as L. P. Burns, Ltd., the head office address remaining the same, namely, 301 Bank of Hamilton Building, with warehouse and shops at Ritchie Ave., Toronto. The firm is manufacturing and repairing steel plate work of all kinds, and light structural work. They are also acting as agents for the Chapman Valve Mfg. Co., Pittsburgh Piping & Equipment Co., American Cement Machine Co. and the Northwest Expanded Metal Co.

The fifth general professional meeting of the Engineering Institute of Canada is being held this week in St. John, N.B.

Montreal's building permits were valued at $1,541,245 for the month of August, an increase of $482,981 as compared with August, 1918. For the eight months of this year the total was $5,913,668, a gain of $2,205,790 as compared with the same period of last year.

A. E. Doucet, director of public works of the city of Montreal, states that 33½ miles of roadways have been given one coat of bituminous oil this season, and it is his intention to apply a second coat this month. This is the first time that Montreal has used road oil instead of water as a dust preventive on macadam roads.

Frederick Law Olmstead, of Boston, Mass., will address the town planning meeting at Ottawa, October 17th and 18th, on "The Fundamental Principle of City Planning." This meeting will be jointly held by the Canadian and United States town planning institutes, and many prominent town planners and architects from the United States will likely be in attendance.

A. W. Campbell, Dominion Highways Commissioner, addressed the Union of Nova Scotia Municipalities August 27th at Yarmouth, N.S., on "Federal Assistance in Road Improvement." Among the other speakers were W. G. Clarke, chairman of the Nova Scotia Highways Board, and J. W. Roland, the board's chief engineer, both of whom discussed the work of the board in its relation to the roads of the province.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand or proposed, contracts awarded, changes in staffs, etc.

TENDERS PENDING

Further information may be had from the issues of *The Canadian Engineer*, to which reference is made.

PLACE OF WORK	TENDERS CLOSE	ISSUE OF	PAGE
Chapleau, Ont., school	Sept. 15.	Aug. 21.	48
Depot Harbor, Ont., wharf	Sept. 12.	Aug. 28.	46
Melfort, Sask., switchboard, wire, etc.	Sept. 16.	Sept. 4.	52
Matilda Township, Ont., culverts	Sept. 12.	Sept. 4.	45
Montreal, Que., timber	Sept. 16.	Sept. 4.	52
Petit Rocher, N.B., breakwater	Sept. 16.	Sept. 4.	52
Quaco, N.B., breakwater	Sept. 17.	Sept. 4.	52
Riverside, Man., bridge	Sept. 13.	Aug. 28.	268
South Mountain, Ont., roads	Sept. 12.	Sept. 4.	46
York Township, culverts	Sept. 13.	Sept. 4.	54
York Township, Ont., meter house	Sept. 13.	Sept. 4.	54
York Township, Ont., water mains	Sept. 13.	Sept. 4.	54

BRIDGES, ROADS AND STREETS

Amherstburg, Ont.—County Council will construct bridges over the Faucher drain, the Botsford bridge at Rose Hill cemetery and on the 7th concession of Malden. W. H. Knister, superintendent of good roads.

Amherstburg, Ont.—Imperial Bank is preparing plans for a bank and office building. C. A. Cuddy, manager.

Belleville, Ont.—City council intends to construct an asphaltic concrete pavement on part of West Bridge St., estimated to cost $11,665, and a Portland cement sidewalk on the west side of Ann St., from Bridge St. to Dundas, estimated to cost $1,582.68. City clerk, J. Wilfred Holmes.

Brockville, Ont.—Preliminary construction work has commenced on grubing and draining the provincial highway, from Brockville to Gananoque. Culverts, ditches and underdrainage will be commenced soon. The final surfacing of this road will not be completed until next season. Engineer Baldwin, Gananoque.

Caughnawaga, Que.—Tenders addressed to Duncan C. Scott, Deputy Superintendent-General of Indian Affairs, Department of Indian Affairs, Ottawa, and endorsed on the envelope, "Tenders for Road Work, Caughnawaga Indian Reserve, Que.", will be received up to noon, September 19th, 1919. Plans and specifications may be seen at the office of the Indian agent at St. Constant, and at the post-office at Caughnawaga, and may also be examined at the department in Ottawa.

Chatham, Ont.—Board of works contemplate construction of pavement on Queen St. South. H. A. Hammond, mayor.

East Oxford, Ont.—Tenders will be received by F. G. Jackson, clerk, East Oxford, Oxford Centre P.O., Ont., until noon, September 15th, for the construction of the Tuttle drain.

Fort William, Ont.—The federal government will improve trunk roads and the highway through the Thunder Bay district and the road from Nipigon to Fort William this season. Estimated cost of roads and bridges, $115,000. C. W. Jarvis, M.L.A.

Galt, Ont.—City council passed by-law for the construction of a pavement with curb and gutter on part of Wellington St. City engineer, W. H. Fairchild.

Hawkesbury, Ont.—Tenders will be received until 8 p.m., September 15th, by town council for construction of permanent roads, both of bituminous and macadam on Main, McGill and Regent St. Engineer, V. E. A. Belanger, L'Orignal. Town clerk, Eug. Paquette.

Kingston, Ont.—City council will construct sidewalks on Stephen St., North St., and Mack St. Ald. Graham, chairman, board of works.

Kingston, Ont.—The Kingston Suburban Road Commission, who received tenders last Monday for seven miles of water-bound macadam highway, are contemplating the award of further mileage, as the commission has a total of about forty-four miles of road to be built, some 16 ft. and some 9 ft. in width. It is the intention of the commission to surface this macadam with bituminous or other material at a later date.

Leamington, Ont.—Tenders for the dredge cutting and embankment, reinforced concrete and other works, and furnishing and installing a new submerged centrifugal pump in the repair and improvement of the Big Marsh drainage system in the Township of Pelee Island, Ont., will be received by Alex. Baird, C.E., Leamington, up to 12 o'clock noon, Thursday, September 18th, 1919. Plans and specifications may be seen at the office of the engineer.

Minitonas, Man.—Tenders will be received until noon September 15th, by the council of the rural municipality, for construction of the following roads, from N.E. corner, section 12-35-27 W., southerly to S.E. corner, section 1-35-27 W. Thence westerly to S.W. corner, section 1-35-27 W. From N.E. corner of N.W. ¼ section 15-36-24 W., along road diversion north of C.N. Ry. right-of-way, to point east of section 13-36-25 W. From N.E. corner, section 10-36-25 W. easterly to N.E. corner, section 12-36-25 W., thence north to C.N. Ry. track. From N.E. corner, section 32-36-25 W. northerly to N.E. corner, section 20-37-25 W. From N.E. corner, section 35-37-26 W., to N.E. corner, section 11-38-26 W. From N.E. corner, section 11-38-26 W. to N.E. corner, section 8-38-26 W. J. H. Cannon, secretary-treasurer.

Montreal, Que.—Tenders will be called for the reconstruction of Guy St. and Cote des Neiges Rd., and for the repair of Notre Dame St. West, between Chaboillez Sq. and Dominion St. City engineer, Mr. Doucet.

Montreal, Que.—The reconstruction of St. Lawrence Blvd., from Craig St. to Ontario St., and of St. Denis St., between St. Catherine St. and Ontario St., is to be undertaken by the Public Works Department at once, and the work is to be rushed through to completion before the fall.

Odessa, Ont.—Contract has been awarded for construction of bridge to Gibson & McGinnis. Construction will commerce as soon as the bridge contract at Westbrook, Ont., has been completed. Charles Grass, county superintendent, Westbrook.

Orillia, Ont.—Town council will construct pavements at the intersections at Penetanguishene, Neywash and West St., and contemplate paving Matchedash St. from Coldwater to Colborne St. D. C. Anderson, mayor.

Orillia, Ont.—Tenders will soon be called by town council, for construction of sidewalk on north side of Mississaga St. from Matchedash to Front St. D. C. Anderson,

Orillia, Ont.—A new concrete and steel bridge over the Narrows is being constructed by the G.T. Ry.

Oshawa, Ont.—Contract has been awarded by town council for construction of concrete sidewalks to T. B. Mothersill, Oshawa. W. G. Worden, town engineer.

Pembroke, Ont.—Council contemplates construction of granolithic sidewalks on south side of Cemetery St., from Dominion St. to James St. W. J. Moore, town engineer.

Rosser, Man.—Tenders will be received by W. H. Beachell, secretary-treasurer, up to 12 o'clock noon, September 15th, 1919, for the following work: Grading about 10,000 yards on the Lilyfield Rd.; for grading and ditching about 1,000 yards on the C.P.R. Rd., between Bergen and Rosser; gravelling about five and one-half miles on C.P.R. Rd., and for gravelling about one and one-half miles on the Rosser Rd. Specifications can be seen at the office of the Highway Commissioner, Winnipeg.

St. Armand Sta., Que.—No tenders were received by the Good Roads department, Quebec, for gravelling roads in parish of St. Armand West. G. Bradley, secretary-treasurer.

St. Bruno de Montarville, Que.—Tenders will be received until 7 p.m., September 15th, by Frederic Huet, secretary-treasurer, for the construction of a gravel road, the road known as "Chemin des Vingt," culverts and ditches included, over a distance of about 12,363 feet. Plans and specifications can be obtained at the office of the secretary-treasurer.

St. John's, Que.—Contract has been awarded to the Richelieu Quarry Co., for improvements of St. Luc Rd. from city limits of St. Johns to town limits of Laprairie.

Trail, B.C.—Contract has been awarded by city council for construction of sidewalks and retaining wall to the Grand Forks Concrete Co. Contract price, $7,900. Rejected tenders, J. H. Freney, Rossland, $15,845; Medby & Vestauney, $13,025, R. D. MacDonald, $12,600. The following tenders were received from cross-walks, J. H. Freney, $1,112; Grand Forks Concrete Co., $1,160; R. D. MacDonald, $1,056. W. E. B. Monypenny, clerk.

Vancouver, B.C.—On September 30th ratepayers will vote on a by-law to provide $160,000 for rebuilding and repairing the Connaught bridge, and another for $100,000 for street improvements. City clerk, W. McQueen.

Windsor, Ont.—On Sept. 20th, the ratepayers will vote on by-laws to raise $30,000 for sidewalks, and $20,000 for the purchase of two street flushers.

Windsor, Ont.—City council proposes to construct the following concrete sidewalks: Gladstone Ave., e.s., Ontario St. to Terminal Ry., 2,900 ft., w.s., Giles Blvd. to Terminal Ry., 2,800 ft.; Moy Ave., both sides, Giles Blvd. to Terminal Ry., 2,800 ft.; Hall Ave., both sides, Giles Blvd. to Terminal Ry., 2,800 ft.; Benjamin St., w.s., Ottawa St., 300 ft.; Langlois Ave., e.s., Ottawa St. to 200 ft. s. of Banwell St., 800 ft., w.s., Ottawa St. to Tecumseh Rd., 3,600 ft.; Huron St., s.s., alley w. of Pierre to Hall Ave., 400 ft., and from Moy Ave. to easterly city limit, 450 ft.; Ottawa St., s.s., eastern city limit to Pierre Ave., 1,200 ft., n.s., Pierre Ave. to Marion Ave., 350 ft., and from Moy Ave. to Gladstone Ave., 350 ft.; Goyeau St., e.s., end of walk to Ellis Ave., 400 ft., w.s., end of walk to 300 ft. w. of Shepherd St., 650 ft.; Dufferin Pl., w.s., Tecumseh Rd., w. 100 ft., and Ellis St., 400 ft. w., e.s., Giles Blvd., s. 500 ft., and from Wyandotte St. to Ann St., 900 ft., Pelissier St., w.s., end of walk to 1,100 ft.; e.s., from Giles Blvd. w. 300 ft.; Janet Ave., w.s., end of walk s. 100 ft.; Louis Ave., e.s., Erie St. to Giles Blvd., 1,260 ft., and w.s., end of walk to Giles Blvd., 800 ft.; Cameron Ave., e.s., end of walk, 200 ft. s. of Wyandotte St., 850 ft.; McKay Ave., e.s., Wyandotte St. to Union St., 850 ft.; Pine St., s.s., Dougall Ave. to Janet Ave., 900 ft.; Ontario St., w.s., Church St. to Bruce Ave., 400 ft. Estimated cost, $30,000. M. A. Brian, city engineer; M. A. Dickinson, city clerk.

Winnipeg, Man.—City council intends to construct granolithic sidewalks on several streets. City clerk, C. J. Brown.

Winnipeg, Man.—City council intends to construct the following asphalt pavements: Logan Ave., from East St. to McPhillips St., estimated cost $128,948; Montrose St., from Academy Rd. to Wellington Cres., estimated cost $6,955; and Montrose St., from Academy Rd. to Kingsway, estimated cost $14,386. City clerk, C. J. Brown.

Winnipeg, Man.—A. McGillivray, Provincial Highway Commissioner for Manitoba, who recently returned from an inter-provincial conference of government good roads representatives, announced that Manitoba's share of the $20,000,000 appropriation by the federal government for construction of good roads will amount to $1,602,265.

Woodworth, Man.—Tenders will be received by W. V. Stevenson, secretary-treasurer, Woodworth Municipality, Harding, Man., up to noon, September 13th, for the construction of three concrete culverts. Plans and specifications may be obtained from the office of the Highway Commissioner, Parliament Buildings, Winnipeg, or from Mr. Stevenson.

York Township, Ont.—Township council intends to extend Woodville Ave. from its present westerly terminus, westerly to Don Mills Rd. W. A. Clarke, township clerk.

York Tp., Ont.—By-laws calling for the building of three miles of concrete sidewalks, four or five feet wide, with a 6-inch curb, have been adopted by the township council. Township clerk, W. A. Clarke, 40 Jarvis St., Toronto.

WATER, SEWAGE AND REFUSE

Amherstburg, Ont.—By-law is being prepared providing for construction of extensions to the Watson Iler drain, 1st concession, Township of Colchester South. Estimated cost, $2,351. J. H. Madill, township clerk.

Belleville, Ont.—City council intends to construct sanitary sewers on several streets. Estimated cost, $13,891.57. City clerk, J. Wilfred Holmes.

Galt, Ont.—City council passed a by-law for the construction of a sewer on Simcoe St. City engineer, W. H. Fairchild.

Gravelbourg, Sask.—The town council has made application to the Local Government Board for permission to construct a waterworks and sewage disposal plant. Town clerk, George Hebert.

Lethbridge, Alta.—The ratepayers defeated a by-law to spend $35,000 for the installation of water meters.

Lindsay, Ont.—Engineer Oliver Smith presented a plan to the town council, showing a system of storm sewer construction. Estimated cost, $6,000. The matter will be dealt with later.

London, Ont.—City council intends to construct a sanitary sewer system estimated to cost $88,737.50. City clerk, S. Baker.

London, Ont.—Tenders will be received until 4 p.m., (daylight saving), September 15th, for construction of approximately 1,700 lin. ft. 15-in. tile, sewers, 1,800 lin. ft. 12-in. tile sewers, 800 lin. ft. 10-in. tile sewers, and 7,000 lin. ft. 8-in. tile sewers. H. A. Brazier, city engineer.

London, Ont.—Manager Buchanan, of the Utilities Commission, says the commission will not undertake anything further than the building of a new reservoir at Springbank in connection with the plan to increase the water supply of the city next year. His estimate on the cost of this work is $200,000. An outside engineer will be asked to prepare an estimate before the plans are completed. In connection with the new reservoir it is planned to build a new supply line from Springbank to the city, but this part of the work will not be undertaken until 1921 in all probability.

Moose Jaw, Sask.—Tenders for the construction of the Britannia Park infiltration gallery project were received as follows: C. U. McManus Co., $27,709.40; Carter-Halls-Aldinger Co., $33,653, and P. W. Graham, $35,761. City council awarded contract to C. U. McManus Co. G. D. Mackie, city engineer.

Moose Jaw, Sask.—Four tenders were received for extensions to sewer and water connections as follows: A. E. Hamilton, $15,373.79; C. U. McManus, $15,934.75; Carter-Halls-Aldinger Co., $18,129.30; P. W. Graham, $19,435. City council awarded contract to C. U. McManus Co. G. D. Mackie, city engineer.

Nelson, B.C.—In a report to council, which was adopted, A. L. McCulloch, engineer, recommended the present 14-in.

Brant Road, Galt, Ont. Tarvia modified modern pavement built in 1911. Treated with "Tarvia-B" in 1916.

A view of St. Andrews Street, Galt, Ont. Surface-treated with "Tarvia B" in 1916 and 1918.

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Tarvia Streets in Galt, Ont., have made good—

BRANT ROAD, shown above, was constructed in 1911 with "Tarvia-X." In 1916 it was treated with "Tarvia-B." The photograph was taken two years later, and a finer street would be hard to find. Not a hole or a patch or a ravelled spot in the whole stretch !

And this street can be *kept* in first class condition for many years with an appropriate Tarvia treatment at very small cost.

The small photograph in the oval shows St. Andrew's Street, built originally as a waterbound macadam street and treated with "Tarvia-B" in 1916 and again in 1918.

This street shows what can be done by surface-treating old water-bound macadam with Tarvia if it is taken in time. Systematic surface treatments with Tarvia will keep this road in fine condition indefinitely.

Tarvia is ideal for city and town residental streets because a Tarvia street is dustless and mudless and easy to keep clean. Taxpayers like Tarvia streets because of these features, and also because they can be maintained very economically.

Galt is only one of the scores of Canadian cities and towns that are solving their street problems with Tarvia.

If your community is facing any road construction or re-construction problems, or if you require an efficient dust preventive, road preserver or patching material, it will certainly pay you to investigate Tarvia.

Special Service Department

This company has a corps of trained engineers and chemists who have given years of study to modern road problems. The advice of these men may be had for the asking by anyone interested. If you will write to the nearest office regarding road problems and conditions in your vicinity, the matter will be given prompt attention. Booklets free.

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MONTREAL TORONTO WINNIPEG
VANCOUVER ST. JOHN, N.B.
HALIFAX, N.S. SYDNEY, N.S.

pipe line, supplying water to the town, be overhauled until such time as it is found possible to replace the entire pipe line. Surveys to be undertaken to ascertain amount of water available from Cottonwood Creek for waterworks purposes. In the near future, to construct a new conduit from a point below east fork of the creek, an additional length of 4,000 or 4,300 lin. ft., giving an increase of 200 ft. head. Total length of new line, approximately 14,500 lin. ft. Pipe recommended, 10-in. to 12-in., 14 gauge, steel pipe. Estimated cost of repairs, $42,000. Estimated cost of new pipe, $44,000 to $50,000. Present capacity of conduit, 1,750,000 gals. per day. Future capacity, 3,000,000 gals. per day.

Orillia, Ont.—Town council has decided to construct a storm sewer along Neywash St. to the lake. D. C. Anderson, mayor.

Oshawa, Ont.—Contracts have been awarded by town council for construction of 15-in. sanitary sewers to J. H. McKnight Construction Co., Ltd. Contract price, $27,880.W. G. Worden, town engineer.

Regina, Sask.—It is stated that the provincial government is considering a scheme to divert water from the South Saskatchewan River, near Elbow, to supply Moose Jaw, Regina and other cities and towns along the line.

St. John's, Que.—City council authorized construction of a sewer on Jacques Cartier St. from St. Charles to St. Paul.

Windsor, Ont.—The Essex Border Utilities Commission has awarded the contract for the construction of the Walkerville sewage pumping station to the R. Westcott Co., Ltd., of Windsor. The construction is to be started at once. Contract price is in the neighborhood of $13,000.

Windsor, Ont.—City council will submit by-law to ratepayers providing for construction of water mains on the following streets: Howard Ave., from Tecumseh Rd. to south limits; Martin St., from McEwan Ave. to Campbell Ave.; Brant St., from Pierre Ave. to alley east of Langlois; Ottawa St., from Gladstone Ave. to Hall Ave.; Moy Ave., from Ottawa St. to south limits; Hall Ave., from Ottawa St. to south limits; Windsor Ave., from lot No. 31 to Shepherd Ave.; Shepherd Ave., from Windsor Ave. to McEwan Ave. M. E. Brian, city engineer.

York Tp., Ont.—The Municipal and Railway Board has approved of the plans submitted for 12-inch trunk water mains on Bathurst St. and Connaught and Lonsdale Aves.

"EXTENSION OF TIME"

The time for receiving tenders for the "Office Furniture" for this building, is hereby extended to Noon, September 13, 1919.

JOHN A. PEARSON, Architect,
J. O. MARCHAND, Associate,
Centre Block, Parliament Hill, Ottawa.

Ottawa, September 5, 1919. 348

WANTED.—A first-class, Experienced, Operating Engineer, to take full charge, and be capable of managing Water Works Plant in Ontario City, with High-Duty Pumps; also Steam Turbine and Electrically Driven Motor Pumps, with Staff of Operating Engineers and Firemen. None but thoroughly competent man need apply, stating experience and references. Address Box 7, *The Canadian Engineer*, Toronto.

PATENT NOTICE.—Any one desiring to obtain the invention covered by Canadian Patent No. 179219, granted September 11th, 1917, to Dennis H. McBride, of New York City, U.S.A., for rosary, may do so upon application to the undersigned, who are prepared to supply all demands on the part of the public for the invention and from whom full information may be obtained. Fetherstonhaugh and Co., 5 Elgin St., Ottawa, Canada. Russel S. Smart, resident. 349

York Tp., Ont.—The township council awarded contracts for over four miles of 6-inch water mains and passed by-laws providing for several miles more. The contracts, amounting in all to $100,000, were awarded to Peter Iles, the Murphy Contracting Co. and Angelo Cavotti. The work is for Oakwood, Mount Dennis and Swansea. This year the council will have spent $350,000 on water mains. Previous expenditures have amounted to $600,000.

York Tp., Ont.—Preliminary steps will be taken by the township council to lay water mains over a mile in length in the Spadina Road district, as follows:—Forest Hill Road from Spadina Road to Huron Street, 800 feet; Huron Street, from Coulson Street to Forest Hill Road, 2,800 feet; Burton Road, from Kendal Avenue to Brunswick, or to the west end, 320 feet; Clairmont Road, from Bathurst to east end, 496 feet; Westmount Drive, from Bathurst east and south to the south end, 1,291, a total of 5,707 feet. Engineer, Frank Barber, 40 Jarvis St., Toronto.

LIGHT, HEAT AND POWER

Cobalt, Ont.—The Wendigo Power Co., with head office in Guelph, Ont., has been incorporated under the laws of the Dominion for the purpose of developing hydro-electric power on Wendigo Lake and certain parts of the Blanche River, including the storage rights on upper waters. The company's plant will be located some twenty miles south of Larder Lake, and officials claim that a ready sale of 2,000 horse-power, to be developed immediately, is assured. The intention of the management is finally to develop 3,000 to 4,000 horse-power.

Hanley, Sask.—Tenders addressed to A. Holm, secretary-treasurer, Hanley, Sask., will be received up to 6 p.m., September 24th, 1919, for the supply, delivery and erection of machinery and materials and the performance of certain works. Murphy and Underwood, Saskatoon, Sask., consulting engineers. (See official tender advertised in this issue.)

Minitona, Man.—Tenders addressed to J. W. Pugsley, secretary, Department of Railways and Canals, Ottawa, will be received until 12 o'clock noon, Monday, September 29th, 1919, for the Bobcaygeon Section, Trent Canal. Plans and specifications can be seen at the office of the Chief Engineer of the Department of Railways and Canals, Ottawa, and at the office of the Superintending Engineer, Trent Canal, Peterborough, Ont.

Winnipeg, Man.—Thomas Kelly and Sons, contractors, are the successful contractors for the Big Turkey Creek sewerage construction, Kansas City, Missouri. Contract price, $2,500,000.

Welland, Ont.—By-law has been passed by city council providing for extensions and improvements to the Hydro-Electric Power system. Estimated cost, $35,000. C. M. Stapf, clerk.

York Township, Ont.—Township council contemplates purchase of lines of the Toronto Electric Light Co., located in township. Construction of the Hydro lines will begin immediately.

RAILWAYS

Hamilton, Ont.—Plans have been prepared by the Hydro-Electric Power Commission for construction of radials from Hamilton to Toronto. It is expected that work will commence soon.

London, Ont.—According to an announcement recently made by Sir Adam Beck, western Ontario is to have a new hydro radial running from Hamilton through Brantford, Burford, Woodstock, Ingersoll and Dorchester to join the municipally-owned London and Port Stanley Railway between this city and St. Thomas, probably in the vicinity of Westminster.

Nanaimo, B.C.—Ratepayers seek extensions of the C.N. Ry., from Nitinat Lake along the grade of the Imperial

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Munitions Board logging road to the head of the lake and the Nitinat valley. R. Macdonald, Lumni Bay Canning and Packing Co.

Preston, Ont.—Construction of track has commenced on the Preston-Kitchener and on the Preston-Hespeler lines of the Grand River railway.

Prince Albert, Sask.—The railway from Fort McMurray country to Prince Albert, proposed by Lord Rhondda, previous to the recent war, may now be constructed.

Toronto, Ont.—Works Commissioner R. C. Harris has sent on to the city solicitor, to be forwarded to the Ontario Railway Board, the plans for the Mount Pleasant car line. The plans provide for an expenditure of slightly under $1,000,000 for three miles of track, via St. Clair Ave. and Mount Pleasant, to Glen Echo.

FACTORIES AND LARGE BUILDINGS

Barons, Alta.—Board of education will erect an eight-room school. Architect, Mr. Whiddington, Lethbridge.

Belleville, Ont.—Tenders addressed to H. F. McNaughton, secretary, Parliament Buildings, department of public works, Toronto, will be received until Tuesday, September 16th, 1919, for a single and double cottages to be erected on the grounds of the Ontario School for Deaf, Belleville. Plans and specifications may be seen at the office of the bursar at the school and at the department of public works, Toronto.

Calgary, Alta.—Construction work will start October 1st on a new "Allen" theatre, to be located on Eighth Ave. Including the cost of the property, the new theatre will be erected at an expenditure of approximately $500,000. Architect, C. Howard Crane, Windsor, Ont.

Cap de la Madeliene, Que.—Contract for building a new office for the Banque Nationale has been awarded to Joseph Blais, of Levis, P.Q., for $19,000.

Charlottetown, P.E.I.—H. and S. Lowe have been awarded the contract for building a new machine shop for Bruce Stewart and Co., Ltd.

Edmonton, Alta.—Board of education will erect a two-roomed school at Forest Heights, extension to Parkdale school $15,000, repairs to King Edward school $2,000, eleven portable schools of one room each at Norwood, Oliver, Alex. Taylor, McAulay, Allendale and Riverdale. Total estimated cost, $62,000.

Fort William, Ont.—A. Snelgrove has purchased a site for the erection of an elevator. Construction work will probably begin next spring.

Fort William, Ont.—A company has been formed to construct and operate a large, modern skating rink building, to be completed and in operation by December 1st. Estimated cost, $75,000. Charles Birkett, chairman of committee.

Guelph, Ont.—A movement is on foot for the construction of a new skating rink.

Hamilton, Ont.—A new theatre is to be erected at the Delta, and will be controlled by the same management which now operates the Queen's and Empire on Barton St. and the New Strand on King St. East.

Hamilton, Ont.—It has been announced that the T. Eaton Co., Ltd., has decided to erect an addition to its factory here at a cost of $100,000, and that Wood, Alexander and James will shortly begin the erection of a warehouse at the corner of King William St. and Fergus Ave. costing $280,000.

Kitchener, Ont.—Application has been made by the Ames Holden Co. for a permit to erect in this city a two-story factory 100 by 145 ft. The contract has been let to Dunker Bros.

Montreal, Que.—Contract has been awarded by the Montreal Locomotive Works, to D. G. Loomis and Sons, for extensions to plant.

Montreal, Que.—Contract has been awarded by the United Shoe Machinery Co. to D. G. Loomis and Sons, for extensions to plant. Contract price, $44,000.

Montreal, Que.—I. H. Laing has awarded contract for construction of stores and warehouses to Archambault and Co., 610 Lafontaine Pk. Contract price, $60,000.

Montreal, Que.—Contract has been awarded by the National Breweries, Ltd., for addition to plant, to Atlas Construction Co. Contract price, $450,000.

Moose Jaw, Sask.—City council awarded the following contracts for the erection of comfort station: General work, H. E. Forbes, $6,558.60; heating and plumbing, Moose Jaw Heating and Plumbing Co., $3,493; marble and tile work, Regina Marble and Tile Co., $2,773.25.

Orillia, Ont.—Plans have been prepared and tenders will soon be called for construction of a new stone memorial hospital on Mississaga St. Architect, E. Bird, Toronto. G. Thomson, chairman of hospital board.

Oshawa, Ont.—The purchase of all material for the new buildings of the General Motors Co. is in the hands of the general contractors for the work, Canadian Stewart Co., Ltd., Dominion Bank Building, Toronto.

Oshawa, Ont.—Tenders have been called by B. H. Prack, Lumsden Building, Toronto, for excavating, structural steel, steel sash, roofing and mechanical trades in connection with the erection of five new buildings at the plant of The Pedlar People, Ltd. The buildings will be of the following dimensions: 2 storeys, 80 by 360 ft.; 2 storeys, 80 by 365 ft.; 2 storeys, 70 by 285 ft.; 1 storey, 60 by 285 ft.; 1 storey, 70 by 250 ft. All will be steel construction with brick walls and concrete floors.

Ottawa, Ont.—The time for receiving tenders for the office furniture for the Parliament Buildings has been extended to noon, September 13th, 1919. Architect, John A. Pearson, Centre Block, Parliament Hill, Ottawa.

Point Grey, B.C.—Plans have been prepared for a new building on Fourth Ave. for the Boys' Industrial Home. Estimated cost about $80,000. Government architect Middleton.

Provost, Alta.—Tenders will be received by the Board of Trustees School District No. 2670, Provost, at the office of Andrew Steele secretary-treasurer, Edmonton, up to noon, Saturday, September 20th, for the erection of a school house. Plans and specifications may be obtained from the secretary-treasurer.

Quebec, Que.—Contract has been awarded by the department of public works, Ottawa, for construction of marine warehouse at Quebec, to Peters, Ltd., Quebec.

Regina, Sask.—H. G. Smith, Ltd., will build a warehouse building, 75 by 112 ft., on Broad St., between Sixth and Fifth Avenues, at a cost of $30,000.

Regina, Sask.—Tenders will be received by D. C. McNab, deputy minister, department of telephones, Regina, until one o'clock p.m., Monday, September 15th, 1919, for the erection of telephone exchange buildings at Kamsack, Indian Head, Maple Creek, Melville and Moosomin. Plans and specifications may be seen at the office of Storey and Van Egmond, architects, Regina, or at the telephone exchanges in the towns above named.

Renfrew, Ont.—The Renfrew Refrigerator Co. will construct immediately new additions which will double their present floor space. M. C. Fuller.

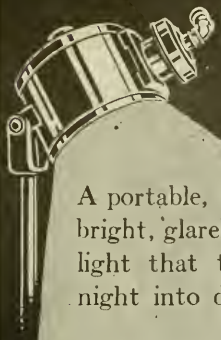
Sarnia, Ont.—The Board of Education authorized the chairman and secretary to sign the amended contracts with S. B. Coon and Son, architects, for the construction of the new Collegiate and Technical School.

Saskatoon, Sask.—A lagre skating rink building, with seating accommodation for 3,000 people, will be erected immediately at the corner of Fourth Ave. and Spadina Cres.

Selkirk, Man.—School board will erect collegiate building. Architect, E. D. Tuttle, McArthur building, Winnipeg.

St. Catharines, Ont.—The Board of Education will purchase a site for the erection of a new Collegiate Institute. Building operations will likely commence next spring. Estimated cost, $180,000 to $200,000.

St. John, N.B.—Gandy and Allison will construct a reinforced concrete and steel warehouse.



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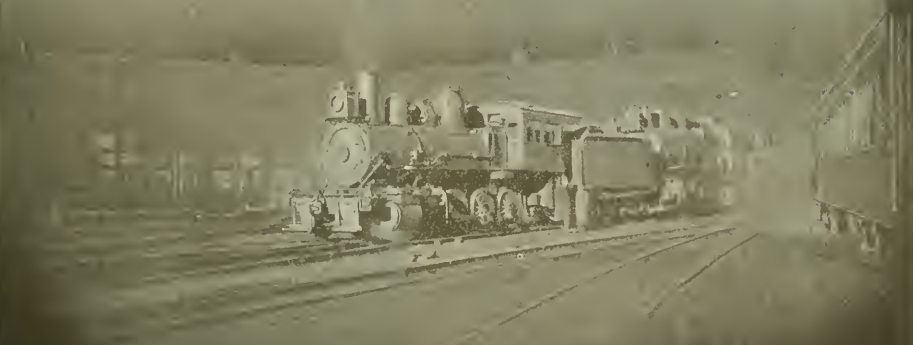

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St. Thomas, Ont.—Tenders will be received until 12 o'clock noon, September 17th, by the board of education for masonry, carpenter work, etc., required in construction of a one-story, six-roomed annex to Myrtle St. school. N. R. Darrach, 430 Talbot St., St. Thomas, architect.

Sydney, N.S.—Contract has been awarded by the Sydney Hotel Co. for construction of concrete and steel hotel building to the G. A. Fuller Co. Capacity of hotel, 170 rooms.

Toronto, Ont.—Board of control sent on to the city council a by-law providing for an issue of debentures amounting to $500,000 for new schools.

Toronto, Ont.—The city architect has issued a permit for the erection of a public school on the corner of Glen Grove Ave. and Rosewell, at a cost of $147,000.

Toronto, Ont.—According to an announcement made by Mayor Church the citizens may probably be asked on January 1st next to vote $1,500,000 for new buildings at the Exhibition grounds, including a live stock arena, estimated to cost $1,000,000.

Toronto, Ont.—Wood, Gundy and Co., C.P.R. Building, have purchased from Strathy and Orpen for $140,000, the five-story building at the north-east corner of King and Victoria Streets, and will spend $70,000 upon internal alterations to the building.

Toronto, Ont.—Esenwein and Johnson, 775-797 Ellicott Sq., Buffalo, are the architects, and Dickie Construction Co., Ltd., Ryrie Bdg., Toronto, are the contractors for the construction of new 500-room extension to the King Edward Hotel. These firms have handled all the construction work, in Canada, of the United Hotels Co.

Trail, B.C.—The Trail Athletic Association intends to construct a large grandstand and improve the athletic grounds.

Waterloo, Ont.—The town council passed a by-law placing the town under the Ontario housing act, and appointing a housing commission. This was done in connection with an offer from the Dominion Rubber Co., to build 100 houses in Waterloo.

Windsor, Ont.—It has been announced that Max Allen, manager of the Windsor Theatre, and ex-alderman Simon Meretsky have purchased property at the corner of London St. and Elm Ave., upon which a $50,000 modern film playhouse will be erected in the spring.

Winnipeg, Man.—W. A. Irish is erecting a brick factory at the corner of Notre Dame Ave. and Erin St., for J. H. Parkhill. Cost, $49,900.

Winnipeg, Man.—The city is going ahead with its housing scheme immediately, and is prepared to spend up to $276,000 on the scheme this year.

Winnipeg, Man.—The C.N. Ry. plans to construct a number of hotels in the mountains along the railway. First hotel to be constructed at Jasper Park, B.C. W. Pratt, manager of hotel services.

Woodstock, Ont.—Canadian Linderman Co. will resume operations on completion of alterations to plant. F. Backstrom, Muskegon, Mich.

Woodstock, Ont.—Bell Telephone Co. will construct a two-story central exchange on Graham St. Construction will probably commence this fall.

Windsor, Ont.—On September 20th the ratepayers will vote on a by-law to grant certain concessions to the Lamb Railway Service Co., in return for the company undertaking to erect a $10,000 factory and to the Fisher Closed Body Co., who propose to erect a five-story building.

Yorkton, Ont.—Arrangements have been completed with H. Bronfman, of this city, for the erection of a new "Allen" theatre. The erection of the Yorkton theatre is said to be the first step in the erection of a large number of theatres in the small cities and towns of Canada by the Allen theatre enterprises.

York Township, Ont.—By-law has been passed by township council providing for construction of two school houses for school section No. 15. Estimated cost, $172,650. W. A. Clarke, township clerk.

MISCELLANEOUS

Comox, B.C.—Contract has been awarded by department of public works, Ottawa, for construction of wharf to the Fraser River Pile Driving Co. Contract price, $17,358. R. C. Desrochers, secretary.

Hamilton, Ont.—Tenders addressed to H. F. McNaughton, secretary, Department of Public Works, Parliament Buildings, Toronto, will be received until Monday, September 15th, 1919, for concrete reservoir to be built on the grounds of the Ontario Hospital, Hamilton, and for an addition to Nurses' Home, Ontario Hospital, Kingston. Plans and specifications may be seen at the office of the Bursar at the above institutions, and at the Department of Public Works, Toronto.

Humboldt, Sask.—Town council will install a centrifugal, direct-connected motor-driven pump, complete with automatic switch. Capacity of pump, 100 gals. per min. F. W. D. Thompson, town clerk.

Kingston, Ont.—Board of works recommended to council purchase of a Sawyer-Massey single tractor 20 h.p. engine. Estimated cost, $2,200. Ald. Graham, chairman, board of works.

Lasalle, P.Q.—Ratepayers defeated the by-law which provided for the borrowing of $131,000 for road improvements, extending and grading of streets and laying water pipes.

Lindsay, Ont.—Tenders will soon be called by the department of railways and canals, Ottawa, for rebuilding wharf. Estimated cost, $10,000.

Little River, N.S.—Tenders, addressed to R. C. Desrochers,, secretary, Department of Public Works, Ottawa, will be received until 12 o'clock noon, Thursday, September 25th, 1919, for repairs to the breakwater at Little Brook, Digby County, N.S. Plans may be seen, and specification obtained at the department of public works, at the office of the district engineer, Halifax, N.S., and at the post office, Little Brook, N.S.

Naramata, B.C.—Tenders will be received until 12 o'clock noon, September 22nd, by the department of public works, Ottawa, for construction of wharf. Plans, etc., at offices of district engineer, Chase, B.C., post offices at Vancouver and Naramata, B.C. R. C. Desrochers, secretary.

Scotch Cove, White Point, N.S.—Tenders will be received until 12 o'clock noon, September 17th, by the department of public works, Ottawa, for construction of extension to breakwater at Scotch Cove, White Point, Victoria County, N.S. Plans, etc., offices of district engineers, North Sydney, N.S., Halifax, N.S., post office White Point, N.S. R. C. Desrochers, secretary.

St. Johns, Que.—City council has authorized the city engineer to purchase a cut-off valve for the water tower.

St. Thomas, Ont.—Tenders, addressed to R. C. Desrochers, secretary, Department of Public Works, Ottawa, will be received until 12 o'clock noon, Thursday, September 18th, 1919, for alterations to plumbing and toilet rooms, post office, St. Thomas, Ont. Plans and specifications may be seen at the offices of the chief architect, department of public works, Ottawa; the caretaker, public building, St. Thomas, Ont., and the superintendent of Dominion buildings, Postal Station "F," Toronto, Ont.

Welland, Ont.—Council proposes purchase of a fire truck for the new fire station under construction at corner of Hellems Ave. and Division St. Estimated cost of new equipment, $15,000. Deputy fire marshal Shannahan.

Winnipeg, Man.—City council will purchase 3,000 lin. ft. of 2 x 5 in. cotton rubber-lined fire hose. C. J. Brown, city clerk.

Winnipeg, Man.—City engineer has been authorized to call for tenders for concrete mixers. W. P. Brereton, city engineer.

Winnipeg, Man.—City council will purchase a small batch concrete mixer, capacity, about one-third yard. C. J. Brown, city clerk.

Windsor, Ont.—On September 20th, the ratepayers will vote on a by-law to raise $15,000 for the purchase of a motor-driven fire engine.

The Canadian Engineer

A Weekly Paper for Civil Engineers and Contractors

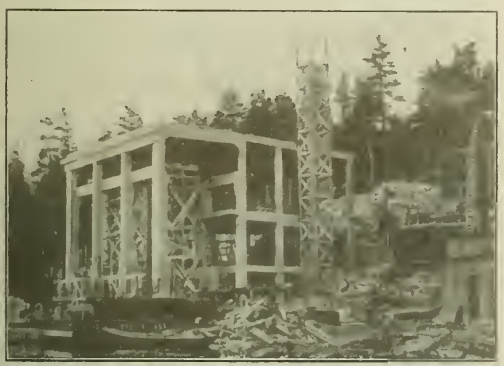
Kipawa Co.'s Pulp Mill and Power Development

First Unit of Bleached Sulphite Pulp Mill Nearing Completion — Ultimate Capacity, 30,000 Tons of Pulp Per Annum — Development of Gordon Creek Utilizes Approximately 200 Ft. Net Head — Wood Stave Power Pipe Line 8 Ft. in Diameter

WITHIN a couple of months the Kipawa Company, Ltd., will have completed the first portion of their construction program in connection with the new pulp mill and townsite at Timiskaming, P.Q.

Situated on the Ottawa river, at the outlet of Gordon creek and adjacent to the Dominion government dams forming the toe of Lake Timiskaming, the site of this new pulp mill is ideal. Pulpwood may be obtained from any or all of four distinct sources of supply: (1) From the northern end of Lake Timiskaming by towing; (2) from the Kipawa Lake district through Kipawa river and chutes to Lake Timiskaming, and thence to plant by towing; (3) from the Kipawa Lake district through Gordon creek, which is an improved creek for lumber interests; and (4) from the south by rail over the Mattawa-Timiskaming branch of the Canadian Pacific Railway.

Upon completion of the full program of construction at Timiskaming, the Riordon Pulp & Paper Co., Ltd., which controls the Kipawa Company, Ltd., will have three large plants supplying material for the pulp and paper industry,



POWER-HOUSE ON LAKE TIMISKAMING

the existing plants being at Merritton, Ont., and Hawkesbury, Ont.

The new plant is being developed under a charter obtained from the province of Quebec, which has leased from the federal government all water rights in connection with the Kipawa lakes for power development or logging on either the Kipawa river or Gordon creek.

The interests of John Lumsden, owner of Lumsden's mill, and of other property owners were purchased, and a compact area of about eleven square miles was brought under control. (See *The Canadian Engineer*, issue of February 27th, 1919, page 260).

Ewing, Lovelace & Tremblay, consulting engineers, Montreal, were instructed to prepare topographical surveys, and Thomas Adams, town planning adviser to the Commission of Conservation, prepared preliminary plans for the model townsite. Upon this plan were located sites for approximately 280 buildings, including churches, hospital, convent, club, hotel, school and institute.

The first portion of the construction program includes the gate house and dam on Gordon creek at Lumsden's mill; a continuous, wood-stave pipe line of 8 ft. diameter; reinforced concrete forebay; riveted steel penstock; power house; combined railway and highway steel girder bridge; barking house; spur lines from the Canadian Pacific Railway; sidings in piling ground; wood room; digestor house; acid

SOME OF THE MILL BUILDINGS—FROM LEFT TO RIGHT, ACID TOWERS, DIGESTORS, SCREEN ROOM, MACHINE SHOP AND SHIPPING ROOM

towers; storage tanks; screen room; bleachery; press room; machine shop; transformer sub-station; boiler house; chimney; shipping room; elevators; office building; dwellings; roads; culverts under the Canadian Pacific Railway line to Kipawa; a continuous, wood-stave pipe line of 4 ft. diameter for supply of water to the mill; revolving screen house on mill supply line; sewers; water mains; pressure filter unit and pumping station.

Construction of the above-mentioned works is expected to be complete by the end of November, and the first unit of the mill will likely be in operation early in December. The first unit represents about 30% of the ultimate planned mill construction, but the work now being done on the townsite is only about 10% of that planned by Mr. Adams and the consulting engineers.

Future construction will include a second 8-ft. continuous wood-stave pipe line to the forebay, or else a tunnel through the hill from the dam at Lumsden's mills to the forebay, or possibly both tunnel and pipe line; four more steel penstocks; additions to power house and its equipment; sewage disposal works or sewage-chlorinating plant; street lighting system; filtered water mains crossing Gordon creek to mill; domestic water storage reservoir; hospital; school; churches and hotel.

To control the waters of Gordon creek at the site of the old Lumsden mill, the Kipawa Company have constructed a reinforced concrete dam with wing walls and foundations anchored to solid rock. The crest of the spillway, elevation

801.12 ft. above mean sea level, raises the level of the impounded water 10 ft. On the south side of the dam is constructed a brick gate house over a 48-in. cast iron gate, which will control the domestic supply through the 4 ft. continuous wood-stave pipe line to the mill. A Bristol recording thermometer has been installed in this building. Adjoining is the log chute opening required by the government

Dam at Lumsden's Mill

for use of the combined lumber interests along the Kipawa lakes. This opening is controlled by a wooden gate, hand operated.

The spillway of the dam consists of 5 bays, each approximately 6 ft. in width. Adjoining the spillway is a control chamber from which connection may be made in the future for operating a new mill, which may be erected on the site of the old Lumsden mill. This chamber is the source of supply for the old hydraulic turbine in the Lumsden mill, which drives the generator that supplies power for the

View of Kipawa Mill from Ontario Shore of Ottawa River, Looking Across Ontario Dam

electric lighting system now being used in the town and on the construction work.

Adjoining this chamber, and at the northerly end of the dam, is the inlet chamber which supplies water for the 8-ft. wood-stave power pipe line. This water is also controlled by a wooden gate, hand operated. The usual trash racks are fitted into both chambers.

Power Pipe Line

The 8 ft. power pipe line, which is completed, is of British Columbia fir, with continuous staves, bound by circular bands and supported on 10 by 10 in. wooden sills and blocks, with wedges in rock cuts and bents for fills.

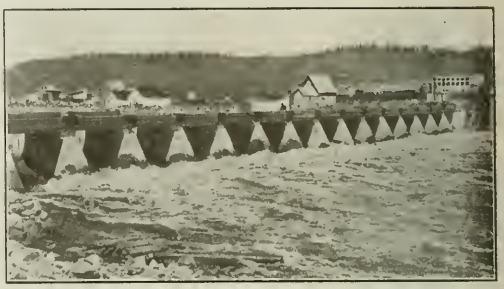
For the greater part of the length, the trench floor was lined to a depth of approximately 12 ins. with one-man-stone and fillers.

From inlet to forebay, the drop in elevation of the pipe line is approximately 20 ft. Along the line has been located 4-in. cast-iron, screw-flange connections, fitted with 4-in. screwed valves, to provide for emergencies such as fire. It was found advisable to clear the ground for 50 ft. on each side of the pipe line to reduce danger from forest fires, one fire which scorched the pipe for a short distance, having threatened the entire line with destruction.

A connection with the pipe line will be constructed to supply the proposed filtration and pumping station with water for domestic use throughout the town, and eventually for domestic use in the mill. The 4-ft. pipe line will continue to supply the mill with water for manufacturing purposes.

Forebay

The forebay is located on side hill. The foundations for the walls and the approaches to the penstock entrances, were drilled out of solid rock. The walls and superstructure are constructed of plain and reinforced concrete, being 36 ins. in



Another View of the Ontario Dam

width at the top and about 20 ft. in width at the base. In plan, the forebay is approximately square, with an area of about 10,000 sq. ft. and a depth of about 25 ft. from crest of spillway, which is 3 ft. below the top of the wall.

This forebay also serves as a surge tank and overflow chamber.

The northerly wall will eventually contain the outlet from the proposed tunnel, which will be approximately one mile in length through the hills to Gordon creek, with intake a short distance above the dam at Lumsden's mill.

Quebec Dam, Ottawa River

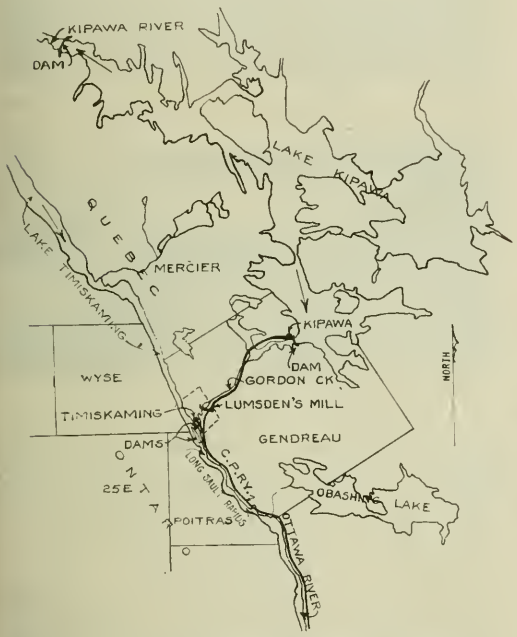
A channel has been drilled and lined with concrete in the rock within the forebay, from the proposed point of entry of the tunnel to the centre line, whence the excavation was carried to full depth and for the entire width. The rock forming that portion of the floor area that was not drilled and blasted, was capped with mass concrete.

The easterly wall contains two hexagonal openings providing for entrance of the present 8-ft. pipe line and for future duplication. The westerly wall contains spillway to Lake Timiskaming; one 36-in. dirty-water drainage-tile pipe; and three vertical rectangular gates, about 36 ins. in width, one of which is a high level, and the other two low level, overflows, hand operated.

The south wall contains the orifices leading through massed concrete to the penstocks, and controlled by hand-operated double gates. It is expected that these gates will later be fitted with electrical controls for rapid closing in emergencies.

Penstocks

At present, only one penstock has been constructed. It is an 8 ft. steel pipe, field riveted, with double-riveted lap joints. This penstock was constructed in a channel about 16 ft. in width by 10 ft. in depth, which was blasted from solid rock, and leads from the northerly orifice of the forebay to the power house, a drop in elevation of approximately 190 ft. Massed concrete anchor piers, four in number, are located between the two structures, and together with the penstock, will eventually be backfilled, thus reducing to a minimum the leakage in joints due to expansion and contrac-



MAP OF THE KIPAWA LAKE DISTRICT, SHOWING KIPAWA CO.'S TOWNSITE AT TIMISKAMING

tion. Within the power house, the flow from the penstock is divided by installation of a wye-branch, controlled by hydraulically-operated butterfly valves. The branches are designed to feed the present hydraulic turbine, No. 1, and a future turbine, No. 2.

Power House

The power house is located on the shore of Lake Timiskaming, about one-quarter mile north of the Canadian Pacific Railway station, and was constructed partially in cofferdam which extended into the lake in water of a depth of 35 to 40 ft. The building is massively constructed in steel and reinforced concrete, with curtain walls of pressed brick, and is plentifully supplied with windows fitted with interlocked double sash. It is divided into two main parts, separated on all floors by fire-resisting doors. The southern, or main, part of the building houses the turbines, generators, switchboards, pumps, governors, excitor and crane, while the remainder houses the transformers, storage room, oil storage, lightning arrestors and disconnecting switches (each of which is housed in a separate concrete box).

WOOD-STAVE PIPE LINE, 8 FT. DIAMETER

The turbine is of standard vertical type, 1,800 h.p. capacity, equipped with Lombard governor.

The capacity of power house will eventually be increased to 18,000 h.p. The southern wall is a wood curtain to permit extension.

Barking House

A short distance above the Dominion government's Quebec dam, and behind the Canadian Pacific Railway's main

POURING WALLS OF CONCRETE FOREBAY

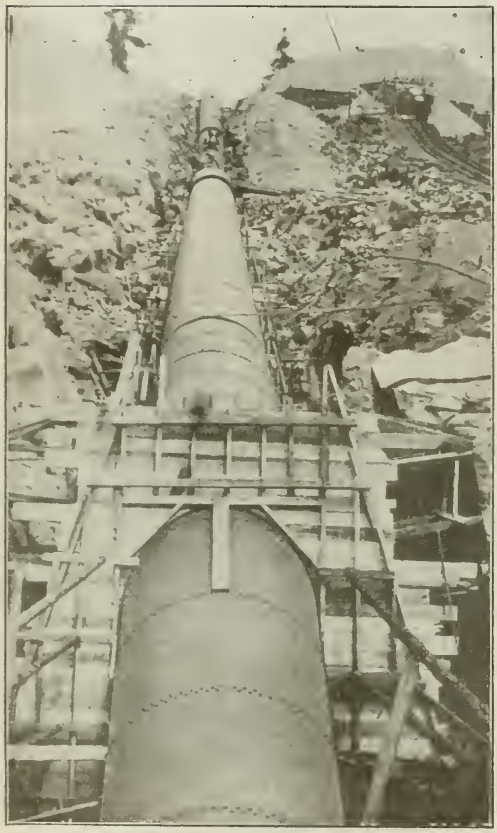
track from Timiskaming to Mattawa, is located the barking plant. The logs are lifted from the lake by endless conveyors, forming a jack ladder to an overhead conveyor platform crossing the railway. The logs are dumped into U-shaped troughs and are continually sprayed with water. In these troughs are revolving discs which rip the bark and pass the log from trough to trough to a loading platform on the spur line and thence to the piling ground. It is to be

DRILLING CHANNEL IN FOREBAY FLOOR

noted in connection with the barking house, that the logs are being handled in 16 ft. lengths instead of the customary shorter lengths. Experiments with this system of rotating discs were made with 4 ft. logs, and the idea has been enlarged to include logs 16 ft. in length.

Piling Ground

After passing through the barking house, the logs are conveyed over the Kipawa Co.'s sidings to the piling ground, in which are constructed five standard gauge tracks with 72-lb. rail. Straddling each track is a wide-gauge



Riveted Steel Penstock

track for an overhead traveller. The centre lines of the five standard gauge tracks have been located about 60 ft. apart to enable the overhead cranes to pile three rows of logs between the tracks and a fourth row on the track as the cars pull out. From the piling ground, the logs are reloaded and conveyed to the wood room, where they are chipped into pieces about ¼ in. by 1½ ins. in size. These chips are carried by an outside, closed conveyor to the top of the digestors.

Digestors and Acid Towers

The digestors, three in number, are housed in a reinforced concrete and brick building, six stories in height. Each digestor is constructed of steel plate, is 17 ft. in diameter and 56 ft. high, and is brick-lined for protection against acid corrosion. The capacity of each digestor per run is approximately 20 tons, and the ultimate capacity of the battery will be about 100 tons a day.

The acid towers are of reinforced concrete, circular, 9 ft. in diameter and 80 ft. high, and at present two in number. They, also, are lined with brick and are insulated by sheet lead. The limestone is loaded into these towers by an elevator located in adjoining rectangular structure. The acid, diluted, is stored in separate tanks which are located near the digestor building.

Screen Room, Bleachery and Press Room

The chips, after passing through the digestor, continue in pulp form through the screen room, where the pulp is thoroughly washed and screened. From the screen room, the pulp goes to the bleachery, and then to the machine shop, where it is rolled into sheets of convenient sizes and pressed into blocks ready for shipment to the paper mills, the hydraulic presses removing nearly all of the moisture.

Boiler House

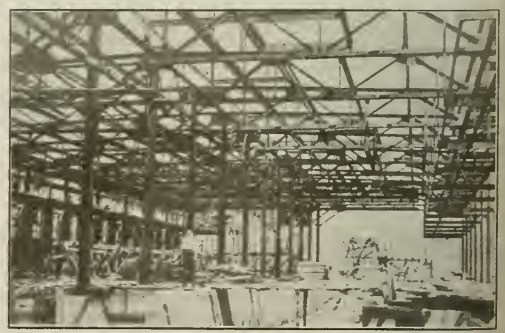
The acid towers digestor room, screen room, bleachery, machine shop and shipping room, are constructed to a uniform street line. Across this street are located the transformer sub-station, boiler house and chimney. The boiler

Jack Ladder and Conveyor Platform

house, also constructed in concrete and brick, contains five Babcock & Wilcox boilers of the superheater type, fitted with economizers, automatic stokers and appliances for using bark as fuel. The chimney, which is about 16 ft. in diameter at the base, is approximately 200 ft. high and was erected by the Canadian Custodis Co.

4-ft. Wood-Stave Pipe Line

The water to be used throughout the mill will be obtained from the dam at Lumsden's mill through a continuous



Machine Room During Construction

wood-stave pipe line 4 ft. in diameter, constructed on bents and sills, supported by a 12-in. floor of boulders and stone, and situated on the southerly side of Gordon creek. The water, controlled by a cast-iron valve in the gate house at

the dam, passes through revolving screens in a building at present under construction immediately adjacent to the gate house. These screens are horizontal, 5.5 ft. in diameter, and 11 ft. long, revolving at 5 r.p.m., and are electrically controlled.

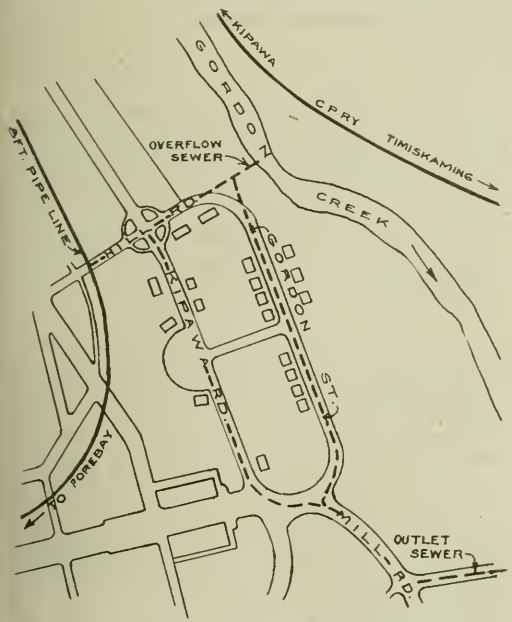
Sewer and Water Mains

Following the recommendations of R. S. & W. S. Lea, consulting engineers, Montreal, it was decided to construct

ANOTHER VIEW OF THE MILL BUILDINGS—WHEN COMPLETED THE CAPACITY WILL BE 100 TONS DAILY

sewers and water mains along Hill Road, Kipawa Road, Gordon Street and Mill Road.

Mains along these streets serve the section upon which are being erected the 36 semi-detached brick houses comprising the first unit of the housing program. Water is obtained by tapping the 8-ft. power pipe line, whence it flows through cast-iron piping into the suction well at the pumping station.



PLAN OF THAT PORTION OF THE TOWN THAT IS NOW UNDER CONSTRUCTION, SHOWING SEWERS

An electrically-driven pump (with a gasoline-engine-driven pump as a standby) will supply the required pressure. Eight-inch and six-inch cast-iron pipe are being laid on these streets, together with necessary hydrants, valves, tees, bends, etc.

Provision has been made for future extensions in any direction required by growth of the population.

Excavation for water and sewer pipe, which are being laid in the same trench, was through a heavy boulder soil, and in many cases solid rock was encountered, necessitating almost constant use of explosives.

The overall difference in elevation between the pumping station and the end of the first section, a distance of about 1,200 ft., is 50 ft. which gives an average grade of 4.2%. Future extensions will cover, possibly, the remaining sections of bench land leading toward the power dam at Lumsden's mill. The pumping station, when completed, will house a small, modern fire station, a filtration unit, suction well and water works equipment.

The sewer pipe commences at the pumping station (the highest point on the system at present), where a 10-in. tile

GORDON CREEK—ONE OF THE FALLS IN THE TOWNSITE OF TIMISKAMING

pipe has been laid. At the intersection of Hill and Kipawa roads, the diameter is increased to 24 ins. and the pipe continues along Hill Rd. to the centre line intersection with Gordon St., at which point an overflow chamber and manhole has been constructed. The overflow will empty over the nearby high bank into Gordon creek. The normal flow will continue down Gordon St. and at Mill Rd. will intersect the main line along Kipawa Rd. From the intersection, the sewer continues about 1,530 ft., ranging from 8 ins. to 24 ins. in diameter, all constructed in vitrified tile. The remaining 309 ft. to Gordon creek is a 24-in. creosoted continuous wood-stave pipe, with outfall at Gordon creek. Suitable concrete manholes, catch basins and stubs for future extensions have been liberally provided.

Turbine Runner Develops Crack

Water was turned into the 8-ft. power pipe, forebay and penstock August 30th, 1919. The installation tested perfectly

with the exception of the runner of the hydraulic turbine. It is said that the runner functioned for only a very short time, when it jammed at full gate opening. Upon examination it was found that the runner had developed a crack from the shaft both ways to the vanes. Fortunately a spare runner had arrived the same day and is now being installed, so it is expected that power will soon be available.

By the end of this month the barking house will be able to handle logs and to prepare a stock for storage at the piling ground. Work is being carried on day and night on some portions of the undertaking, in an effort to produce pulp before December 1st, 1919.

Future extensions to the main mill buildings will be facilitated by the fact that the wall at one end of each structure is merely a wooden curtain wall.

Personnel

The consulting engineer for the Kipawa Co., Ltd., is Hardy S. Ferguson, of New York City, who is represented on the ground by B. T. Weston. C. B. Thorne, chief engineer and technical manager of manufacture of the Riordan Pulp and Paper Co., Ltd., is in active control of the work at Timiskaming. W. L. Ketchen is resident engineer and local manager, with F. O. White as his chief assistant. Allan K. Grimmer is town engineer. The G. A. Fuller Co., of Montreal, are the chief contractors, constructing the mill, with the exception of the acid towers and acid tanks, power house and dam. The Dickie Construction Co., of Toronto, are erecting the houses. McAuslan & Anderson, of North Bay, Ont., are contractors for the sewers and water mains, tracks in the piling ground, outside piping in mill yard, superstructure of bridge crossing Gordon creek, and screen house on 4-ft. pipe line. The Sherwood Construction Co., of Toronto, are constructing the tracks leading to the coal and sulphur storage, which involves considerable rock cut and fill, and also installing the fire protection in the piling ground. Among the other contractors are the Stebbins Engineering Co., Philadelphia, acid towers; Danforth Co., Buffalo, inside piping; Dominion Bridge Co., Montreal, combined railway and highway bridge crossing Gordon creek, and the coal and the chip conveyors; Pacific Coast Pipe Co., Vancouver, both of the wood-stave pipe lines; Rensselaer Valve Co., Troy, N.Y., and Chapman Valve Mfg. Co., Indian Orchard, Mass., gate valves and sluice gates; I. P. Morris Co., Philadelphia, hydraulic turbine; Canadian General Electric Co., Toronto, and Canadian Westinghouse Co., Hamilton, electrical equipment; Herbert Morris Crane & Hoist Co., Niagara Falls, Ont., crane for power house and chain hoists.

Undeveloped Water Powers of New Brunswick

List of Possible Sites Totals 23,000 H.P. (24-Hour Power), Not Including the Grand Falls of the St. John and Nepisguit Rivers—Paper Read Last Week at the Engineering Institute's Fifth Professional Meeting

By C. O. FOSS, M.E.I.C.
Chairman, New Brunswick Water Powers Commission

LAWS governing hydrostatics and hydraulics are so simple that the way-faring may readily understand them, yet I think I may safely say that there are no other natural laws so little understood even by people of high intelligence. There is no engine of equal power which is so simple of construction and installation, so uniformly sure in action, and subject to so little wear and tear and depreciation, as the modern up-to-date hydro-turbine. I need not say that there is nothing miraculous about water power; and that in a comparison of water with other methods of power generation, we may easily make the mistake of spending so much money in the purchase, development and transmission of hydraulic power that the output may cost more than power generated in some other way, especially when the consumption is small and limited. However, these exceptions only serve to prove the very general rule that hydro power is cheaper, surer and more flexible than any other form of power that can be developed in considerable units.

As regards water power possibilities in New Brunswick, it has been considered by the people generally that there are no power possibilities of any value outside of the Grand Falls of the St. John, and a very moderate possibility at the Grand Falls of the Nepisguit, and this opinion has been strengthened by statements to that effect by parties who are supposed to be authorities upon the subject.

Grand Falls Too Remote

If this were true, the distribution of hydro-electric power in centres of population would be well nigh hopeless, for the cost of developing the Grand Falls of the St. John would be so great, and its location is so remote from the centres of population, with the market at present in sight so limited, that the interest and overhead would make the cost greater than power generated by other methods.

To make these powers commercially possible of development and use, the output must be used at or near the site in the manufacture of pulp and paper, the logical large industry for this province. In the case of the Nepisguit power the Bathurst Lumber Co. are having plans prepared for the development and transmission to their pulp and saw mills in Bathurst, and the big power at the Grand Falls of the St. John will be developed in the near future for the same purpose. The parties now controlling the latter power site have a year from the close of the war to start the development, failing which the provincial authorities will take away the control and arrange for the development by other parties.

Then, having disposed of the large power possibilities at the two grand falls, the question naturally occurs: "Where is power to be found for distribution and use in the centres of population?"

For Distribution to Municipalities

The centres of population requiring, and not at present supplied with, hydro-electric power, are three:—

First, Fredericton and vicinity; second, St. John and vicinity; third, the towns on the north shore from Chatham to Campbellton.

Moncton and vicinity has cheap power generated from natural gas.

St. Stephen has hydro-electric from the St. Croix.

Edmundston has a municipal plant on Green river. The Frasers have a development on the Madawaska for use in the pulp mill they have lately constructed. The capacity of this site may be considerably increased by storage on the Temiscouata, and they will be able to get any additional power they may need, when they enlarge their plant, from Grand Falls when that is developed.

Woodstock also has a good hydro plant.

Taking the requirement of Fredericton:—

There are two streams falling into the St. John north of Fredericton, the Pokiok and Shogomoc, 37 and 40 miles, respectively, following the highway which parallels the river, and 30 and 33 miles in an air line.

These streams each drain about 50,000 acres. The Shogomoc falls 300 ft. in the last two miles, and the Pokiok falls 200 ft. in 1½ miles and 100 ft. more in about 500 ft.

Both these streams have excellent opportunities for storage, as they drain a country which is comparatively flat to a point about 2 miles from the St. John river. In other

words, the St. John has eroded a valley 300 to 350 ft. deep, and on this flat country there is opportunity for storing large quantities of water by the building of comparatively inexpensive dams.

These two streams, if fully developed, with all possible storage provided, will yield at least 7,000 h.p. (24-hr. power), or 14,000 h.p. (12-hr. power); or assuming that the working day of the future will be 8 hours, then 20,000 h.p. if the pondage at the different plants be sufficient to take care of the fluctuations.

The plan is to develop a small unit on the lower 100-ft. drop of the Pokiok, protected by the storage which is already provided by the existing dam at the outlet of Lake George. This will give power enough to cover the present requirements of Fredericton, with quite a margin for increase of requirement. When more power is demanded, the first unit can be more than doubled by building a new storage dam about 4½ miles from the St. John. When this is outgrown, the 200-ft. fall can be developed; and when that has been absorbed, the Shogomoc can be developed. This should put Fredericton on the map as a manufacturing centre just as it already is a railway centre.

St. John's Hydro-Electric Possibilities

The second and largest centre of population requiring hydro power is St. John. All the power generated in St. John is by coal, and the New Brunswick Power Co. had to be given a very substantial increase in its rates to meet the greatly increased cost of coal and labor. They have been investigating possible water power for some time and now that the war is over they will have to go ahead with the development very soon.

The Lepreaux river empties into the Bay of Fundy about 20 miles from St. John. The drainage is about the same as the Pokiok or Shogomoc, but the run-off is nearly twice as much. We have three years' continuous run-off records, and we are greatly puzzled to account for the phenomenal run-off, being 133% of the total rainfall recorded in St. John.

The engineer who installed the gauge and took the first two years' records, explained the phenomenal run-off by assuming that the stream is receiving a large amount of subterranean drainage from the watershed of an adjoining stream, but we, having taken several checks of the run-off of this stream find the same phenomenal run-off, which proves conclusively that there must be a much larger rainfall on the watersheds of these streams than there is in St. John, only a distance of a few miles away. There are three power sites on the Lepreaux, two of 90 ft. fall and one of 64 ft., and having in mind the very great run-off of this stream, these three sites will produce at least three times the amount of power now used by the New Brunswick Power Co.

There is one power site known as big falls which can be made to generate 40% more power than they used last year. When St. John and vicinity has absorbed and put to use the 5,000 to 6,000 h.p. that can be developed on the Lepreaux, the Maguadavic, 20 miles further away, can be made to produce as much more. There is no reason apparent why the development of this power should not be put in hand in the near future.

Conditions Along North Shore

The third district where hydro power is required is along the North Shore. Bathurst alone has a small and very indifferently developed and distributed system of hydro-electric power.

Campbellton and Dalhousie drive their plants with gas engines, using gas produced from anthracite coal, and the cost of that makes their power very expensive.

Newcastle uses steam at big expense, and Chatham uses oil engines.

In addition to the requirements of these several towns, the Dominion pulp mill at Chatham requires some 400 or 500 h.p.

The Tete-a-gouche river, which enters Bathurst harbor a little north of the town, drains about 100,000 acres and has an ideal opportunity for very large storage. About 8 miles above its mouth, it enters a deep and narrow gorge of nearly perpendicular rock walls; the fall through this gorge admits of four power sites, each created by a dam built to the top of the walls and flowing the water back to the next dam up the stream. At the first or upper site, a dam 70 ft. high will give a head of 105 ft., there being a sheer fall of 35 ft. in the flow of the gorge. It will flow the water back for about 4½ miles. At the second site a dam can be built to a height of 130 ft.; the third, 65 ft.; and the fourth 35 ft.; or a total of 335 ft. These four sites will put out 6,000 h.p. (24-hr. power), or 18,000 h.p. (8-hr. power).

So it will be noted that while it was represented to the provincial authorities only a few years ago that there is no water power in New Brunswick aside from Grand Falls, we have already been able to locate and fairly well prove (apart from Grand Falls) the existence of 23,000 h.p. (24-hr. power), or nearly 70,000 h.p. (8-hr. power), which if all put to work would produce a big change of conditions in this province.

This commission has only been in existence for a little over a year, and is composed of three men busy with their regular work and so unable to give any considerable amount of time to the matter. Our people in the Maritime Provinces are surely if slowly awakening to the fact that we may overcome to a considerable extent the handicap which the upper provinces hold over us in manufacturing, due to their enormous water powers, by developing what we have discovered and looking for more.

THE BEAR RIVER BRIDGE*

By A. T. Macdonald, A.M.E.I.C.

PRIOR to 1912, the Bear river was crossed by the Dominion Atlantic Railway by a bridge consisting of about 750 ft. of wooden trestle on pile bents and five-Howe truss spans, 150 ft. long, on concrete piers with pile foundation, the piles being cut off about 2 ft. above the original bed of the river. This bridge was used for upwards of 25 years, but the piers were disintegrating rapidly between low and high water marks from the action of the river ice, and were also gradually moving downstream.

This bridge was what one might call "ripe," and certain tired souls had been known to leave the train at Deep Brook and drive by road to Bear river station, or Digby, continuing their journey the next day, in order to avoid crossing the bridge. These people, no doubt, exaggerated the state of affairs, but their nerves were not equal to the strain of travelling over 1,600 ft. of bridge at the rate of two miles an hour.

Our first work there was to make the old bridge safe for traffic until it could be replaced by the new one. This in itself was a very costly proceeding. A double row of piles were driven first, clear of the footings of each pier, and framed bents of 12 by 12-in. spruce erected on these and braced to form a tower. The bottom chord of the truss was given a bearing on this tower about 10 ft. away from the end of the truss, which was reinforced to suit this new bearing.

In this way the old piers, which were increasing their downstream movement, were largely relieved of their loads. The pier supporting the swing span slid downstream to such an extent, 10½ ins. if I remember rightly, that it became impossible to operate it. This necessitated another opening to permit vessels to pass.

Towers on pile bents were therefore erected to support a 40 ft. plate girder about 200 ft. east of the existing swing span, and when everything was in readiness, an opening was cut in the bridge and the girders dropped into position. With the aid of the Dominion Bridge Co.'s derrick car, this was accomplished without any interruption to train traffic.

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*Paper read at the fifth professional meeting of the Engineering Institute of Canada, September 10th-12th, St. John, N.B.

This span was operated as a lift span whenever the occasion arose, the derrick car furnishing the power. The clearance for vessels going through this opening was just about the minimum, and called for expert seamanship on the part of the skippers. On one occasion a 400-ton schooner frightened everyone badly. Part of her rigging fouled the deck of the bridge, and only some very lively play with axes and prompt action by the tug, saved a very nasty situation.

Construction of a new bridge 50 ft. downstream and parallel to the old one was begun in June, 1912, and completed in June, 1914. The design, starting from the west end, called D. T. swing span, one 150-ft. D. P. G., one 100-ft. D. P. G.; one 156-ft. D. P. G.; one 144-ft. D. T. swing span; three 156-ft. D. P. G.; six 100-ft. D. P. G.; and one 85-ft. D. P. G.; the total weight, 2,500,000 lbs. of steel. These spans are carried on concrete piers on pile foundation, with the exception of piers 3, 4 and 5, which rest on a bed of coarse gravel and boulders.

Proximity of Old Bridge

The proximity of the old bridge to the proposed work provided another reason for the expenditure of money to strengthen its foundations. With a distance of only 50 ft. between lines, the noses of corresponding piers on the two bridges lay side by side, and as dredging proceeded for the new pier, in some cases being carried below the points of the piles in the old, the tendency was for the old pier to slide bodily into the excavation. Therefore the work had to be carried on with the greatest care and divers were freely employed to keep the old foundations under close observation. Of course the old bridge in many ways helped in the construction, the contractors being able to utilize it for the running of water lines and trolley lines for conveying materials, etc., and the engineering party for laying out the work and as a ready means of communication from shore to shore. But it was not a blessing, as the cofferdams were on several occasions hung up by old timber and piles.

Layout of Work

From pier 8 to the west abutment, the bridge is on a 6 deg. 10 min. curve to the left, with a central angle of 59 degs. 20 mins. A base line was carefully run over the centre line of the old bridge, and permanent hubs set on each bank, well clear of the work, from which the bridge tangent was located by off-setting 50 ft., and marked by permanent hubs which were used for giving the centre line of all piers on tangent. The transverse centre line of these piers were given from points on the deck of the old bridge. Owing to the movement of the deck, as mentioned above, these points had to be located anew for each day that it was necessary to use them. In order to eliminate as much as possible any chance of error in locating the piers on the curve, it was decided to determine the exact geometric centre of the curve and erect there a sight which would be visible at all stages of the tide. The transverse centres of the piers, being on radial lines, could then be located from hubs on the semi-tangent, using the centre of the curve as a foresight.

Accordingly the P. I. of the curve was found, and as it came on the beach at high water mark, a concrete pedestal 18 by 18 ins. and 2 ft. high was put in on pieces of 4 by 4-in., 8 ft. long, as piles, and on this the P. I. (hub A) was definitely set after repeated checking.

To establish the centre of the curve was more difficult, as the water only left it for about two hours each day. With the transit on A and backsighting on T on the west end of the bridge tangent, an angle of 60 degs. 20 mins. was laid off, and the point of intersection found with a line at right angles to the tangent of the curve at the E. C. Around this point a rock-filled crib 6 ft. square and 4 ft. high was built, and a 2 in. pipe, 24 ft. long, was securely guyed there. (Hub C).

As a check, the calculated distance from P to C was measured on the ground with 100 ft. steel tape over stakes driven to the same elevation and 100 ft. apart. The distances along the semi-tangent from P, where the radial lines for each pier intersected, were then calculated and hubs set.

The distances along the radial line from the hubs to the curve were also calculated and recorded for use when required. A hub was put in at M, the mid-point of the curve, from which the angles of the centre of each pier could be turned as a check on the above method. All measurements were made with a 100-ft. steel tape and corrections made for temperature.

Foundations

The west abutment and piers 1 and 2 were built on solid rock, and the concrete poured in the dry, no pumping being necessary. The foundation of the east abutment is on sand and gravel. The excavation for this was taken down 6 ft. below original ground and piles driven to refusal at a penetration averaging 18 ft.

Piers 12 to 14 were on typical Bay of Fundy mud and dry at low water. Cofferdams of 10 by 10 in. hemlock were built in place and sunk as the excavation progressed, being loaded with old rails to a depth of 18 ft., and piling driven. The penetration averaged 25 ft., the penetration under the last blow being from ½ in. to ¾ in., a 2,400-lb. hammer being used, with a fall of 25 ft. These cofferdams were pumped out and the piling cut off 2 ft. above the bottom and the concrete poured in the dry.

The foundations of piers 9 to 11 inclusive were built in the same manner, but the penetration and number of the piles used increased as they approached mid-stream.

In pier 8 the cofferdam was 21.7 ft. deep and the average penetration of the piles 58 ft. The piles, about 90 in number, were cut off under water and the concrete deposited with a bottom dumping bucket; the bottom of this pier covers an area of 749 sq. ft. and there are 451 cu. yds. of concrete in the footing course. In all the piers the footing course is carried about 4 ft. above low water. Between low water and extremely high water the concrete is sheathed with 4 by 6-in. southern pine, with ½-in. iron plates 2 ft. wide on the angles, attached by galvanized iron bolts 15½ ins. long. All concrete below high water mark is 1:2:4: mixture; above 1:3:6.

The remaining piers, 3 to 7 inclusive, were a somewhat different proposition. At extreme low water the depth of water varied from 20 to 27 ft., and with a rise of the tide of 28 ft., this meant a depth of 55 ft. at high water for pier 3. Borings showed for piers 3, 4 and 5, a belt of fine sand about 8 ft. thick, followed by 8-ft. of mud and then 5 ft. of gravel. At pier 6, 12 ft. of mud, 5 ft. of sand and 60 ft. of mud.

The borings were taken after the work of construction had begun and were very hurried and the information obtained not very dependable. They were taken from a platform in some cases, or from a scow moored over the site of the pier. A 3-in. casing pipe with a 1-in. water pipe attached to a force pump working inside of it, to which the bit was attached, was driven down and the washings examined. A diamond drill was used to penetrate the gravel.

No Solid Rock Encountered

At pier 7 a penetration of about 90 ft. was obtained, at which depth solid rock was reported. The platform from which the borings were taken had to be above high water mark so that the work might go on continuously; so after penetrating the overlying mud there would be about 70 ft. of casing pipe when the gravel was reached. When the inner pipe was raised and allowed to drop on this compact mass of gravel, it bounced up again, giving the impression that solid rock had been encountered. This idea was strengthened when the drilling made no further progress until the diamond was put on. I may say here that no solid rock was encountered at any of these piers when the work was completed.

It was finally decided to sink foundations for piers 3, 4 and 5 down to the gravel, or about 20 ft. of excavation by open dredging. Pier 3 was started first. A double wall cofferdam was constructed with a space of 4 ft. between the walls. The inner wall stopped about 12-ft. short of the outer and they were connected by a solid floor of 10 by 10 in. hemlock, forming a cutting edge. Projecting below this was about 16 ins. of ½-in. steel plate. The cofferdam, about 30 ft. high, was floated into position, the space between the walls filled with concrete, and old rails piled on. Dredging was

(Concluded on page 320)

STREAM FLOW AND PERCOLATION WATER

By Samuel Hall
Assistant Water Engineer, Belfast

(Continued from last week's issue)

LET us now assume that before and after a particular rainfall the stream flow curve has assumed the basic curve form, and at particular times before and after the peak the rate of 2 M.G. per day is recorded; the gain is the total discharge between those two times, because the available amount of percolation water, as indicated by the basic curve, was the same at both times; thus the benefit accruing from a particular rainfall is measured. In this case, should the stream flow curve assume the basic curve form, but not continue so far as to show the rate of 2 M.G., but only, say, 4 M.G. per day, the basic curve can be applied to the flow curve to continue the latter to the time at which the rate of 2 M.G. per day is shown. Then the total discharge, as shown by the flow curve and its continuation, between the two times represents the amount of gain.

Supply and Discharge

This case is illustrated by Fig. 5, which shows an inserted curve EF, which is a reproduction of a part of the basic curve. The time J is fixed by the rate IJ, which is the same as GH. A, B and C show the total gain due to the particular rainfall. A is the estimated surface run-off, whilst B and C show the gain of percolation water. The curve at G must be of basic form, otherwise the principles are not applicable to this case. It was not necessary to draw the portion C, as its equivalent was measurable between ordinates of the basic curve, in this case representing 4 and 2 M.G. per day, but it suffices to illustrate plainly how much more percolation water was in store at the time K than at the time H, and shows what might be called the "correction" for percolation storage. It is suggested that this correction be made in figures representing calculated evaporation loss; and as in cases where these figures are taken over a period the correction might be equivalent to two inches of rainfall, it is plain that uncorrected figures may be inaccurate. Were the basic curve only approximately obtained, it would be of some value for making this correction. The basic curve serves to illustrate the fact that over a period when percolation supply becomes reduced, "depletion" of percolation storage takes place, and this will continue until the average rate of supply and the average discharge are roughly balanced, though neither is actually constant. Conversely, when percolation supply over a period becomes increased, the "filling up" of percolation storage takes place before supply and discharge roughly balance. From another point of view, it might be seen that the average rate of discharge does not immediately change to equal an average rate of supply, but the difference goes to; or is taken from, storage, until the surface of saturation is at such a level that average supply and discharge are about balanced; thus a year's minimum can only occur after a period of small supplies, and a year's maximum only after a period of large supplies.

Maintaining Constant Supply

It occurred to the author originally that if one could determine the available percolation water stored in a drainage area at the end of a winter period, there would be something of value in estimating the amount of artificial storage required to maintain a constant supply, because with a greater amount of natural storage less artificial storage would apparently be necessary. The available percolation storage can be ascertained with the assistance of a basic curve, no doubt in many cases within near limits; yet the author thinks this figure would be of doubtful value, for it is obvious that before percolation discharge can become equal to its average rate, supplies from subsequent rainfall must first replenish the depleted percolation storage according to the amount which has been temporarily available from that source. And for the same reason it is doubtful whether the figure of minimum rate of flow is of much value where a large proportion of the mean flow is required for a constant supply.

The author suggests another use for the basic curve in which it might be of more value. As evaporation during the winter is small and the gains from rainfall should nearly equal the rainfall, the former is the discharge, plus or minus the difference in percolation storage at the beginning and end of a test period. If the difference between the rainfall and the total gain could be accounted for by evaporation, it would be safe to presume that the drainage area was water-tight; if not, there might be proof that percolation water from outside sources was feeding the stream, or, on the other hand, indications of a serious loss of percolation water from the drainage area. In the latter case there would be warning that the installation of a dam might be unfortunate, or even disastrous. There has been sufficient evidence put forward by observers to show that the percolation drainage area is in some cases considerably different from the topographical drainage area, and to consider them as equivalent without satisfactory evidence that such was the case might be an unsound presumption.

Evaporation

The rate of evaporation from water surfaces appears to follow an ill-defined relation to the power of the sun and the duration of sunshine, whilst wind also has a slight influence; but evaporation from a drainage area is influenced by other conditions, such as the soil, percolation rate, elevation and vegetation. The most important factor other than the sun is probably the capacity of the surface soil for moisture. The power of the soil to retain water is known as capillary attraction, and it is a power which defies to some extent the force of gravity. When these conflicting forces are balanced, the amount of water retained in the soil is relatively large (no doubt often equivalent to three inches of rainfall), but very variable, according to depth and fineness, and perhaps also variable with weather conditions. The power of evaporation, due largely to the influence of the sun, appears to be a stronger force than that of the capillary attraction of the soil, for the soil is robbed of part of its moisture, and therefore makes a toll of subsequent rainfall. It is doubtful whether the soil can take its full share from a particularly heavy fall as it requires too much time to do so, and consequently part of the rainfall percolates before the soil is fully satisfied. Though this latter point remains in doubt, it is quite clear that a large part of the evaporation loss in a dry period is replaced from subsequent rainfall, and at times there is but a small balance available to supplement stream flow. In hot, dry months evaporation loss from a drainage area is smaller in the absence of rain than it would otherwise be, because the moisture is not available for evaporation. The surface soil probably draws to some extent upon the subsoil immediately below it, for even vegetation which derives supplies from some depth below the surface has at such times difficulty in maintaining life. Evaporation cannot reduce the percolation storage where the latter is in deep subsoil, but may reduce very slightly the discharge from such a source by evaporation from the stream surface.

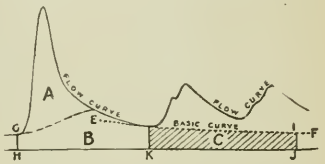

FIG. 5—FLOW AND BASIC CURVES

Figures quoted as calculated evaporation losses from drainage areas, though amended by the correction already suggested, would also include losses due to percolation water escaping from the drainage area, and for these reasons they are of doubtful value. The same remarks apply to the figures given in certain text-books to represent evaporation losses due to different forms of vegetation, as they are probably based on differences between rainfall and stream flow.

Investigations of loss by evaporation have been made by means of percolation gauges, but there does not appear to be such definite agreement between the records as might enable accurate conclusions to be deduced therefrom. It is difficult to see how soil and subsoil can be disturbed and placed in a percolation gauge in a condition equivalent to

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that in which they originally existed, and as in the usual form of percolation gauge no surface run-off is possible, the surface water is exposed to absorption and to evaporation influences for a longer time than it would be on a steep drainage area.

Lag

This term appears to be frequently used to denote the time taken for percolation water to influence flow, and apparently is the result of investigations of the flow of the River Thames, in which there was shown to be a lag of five months between the maximum rainfall and the maximum flow, and the minimum rainfall and the minimum flow respectively. These results were obtained from average monthly figures of a period of twenty years, and it is very questionable whether it is correct to say that percolation water takes five months to reach the river. It is clear that it is not the total rainfall which constitutes flow, but only so much as is available after accounting for losses. If we were able to determine monthly evaporation losses and deduct them from the total monthly rainfall, we might make a diagram of "available rainfall," which from established facts would be relatively very small in summer, and very little different from total monthly rainfall in winter. If five months lag were allowed for, the minimum monthly flow from averages over a number of years would be expected about December, and the maximum flow about May; as this is so different from what actually occurs, it seems clear that the period of five months is incorrect, and moreover it is not even supported by actual monthly records of rainfall and flow. From monthly records of the flow of the Thames, it appears clear that there is no marked difference in point of time between the flow curve of the Thames and those of other British streams and rivers from areas in which geological conditions are a remarkable contrast. It might be reasonably expected that percolation from rain which falls near the banks of the river would feed the surface of saturation close to the river, causing some increase of flow within a very few days at most. It may be noted that percolation equivalent to one inch of rainfall might raise the surface of saturation by several feet if the fissures were of small size. The monthly records of the flow of the Thames appear to the author to show a measure of agreement with his conclusions based on observations from totally different sources; there are indications of depletion of percolation storage towards the end of the summer, and the filling up towards the end of the winter, where the maximum percolation discharge is most liable to occur in not only the Thames, but in every British stream or river.

Snow

Snow is another source of error in calculating evaporation losses from drainage areas; its presence, or any doubt as to its presence, spoils the value of comparisons of precipitation, flow and evaporation. Wherever gaugings are taken, weather conditions, and especially the existence of snow, should be recorded.

Floods

The maximum flood rate, or average rate of a short period, is of importance as the basis for determination of sizes of reservoir culverts and weirs. It is the custom to base calculations on the highest flood rate which obtained in a particular drainage area, and allow a little more to be "on the safe side." Though it may be safe, it is not a very scientific method of determination, for figures which apply to one area do not correctly apply to another. Flood discharge is chiefly surface run-off and is dependent upon a factor which varies for each area, and probably largely on intensity of rainfall, so that unless the latter has been observed in conjunction with stream flow, reliable estimates cannot be made for possible maximum rates.

Springs

The flow curve of a spring is that of percolation water alone. The author would expect a spring flow curve to have similar features to that of a stream flow curve were the "peaks" of the latter removed, and would expect the principles stated to be capable of application in most cases.

There should be little need to repeat what many observers have already stated, that to apply to any one area figures obtained from another is obviously wrong. Evaporation loss is known to vary considerably in different areas, and percolation loss cannot be determined by a mere inspection of a drainage area. Thus calculations and estimates of storage capacity, size of weir and outlet culvert, based on "rule-of-thumb" formulæ and so-called "judgment" are liable to lead, and have in some cases led, to waste of money. On the other hand, stream flow data can be had at a cost which is small in comparison with that of a water supply scheme, and which might often be saved many times over in the reduction of the size of the weir and outlet culvert. There is much need for further investigation of stream flow and evaporation, subjects which particularly concern water engineers, and which have been sadly neglected up to the present. Every drainage area has its peculiarities due to conditions therein, and all the conditions, so far as they concern water engineers, can probably be determined by investigation of the flow curve. To investigate the smaller rates of flow, it is advisable to use V notches, or a small weir in conjunction with a larger one at a higher level, also automatic recording apparatus.

TOWN-PLANNING IN WESTERN CANADA*

UNFORTUNATELY, owing to the conditions under which municipalities in Saskatchewan may borrow, it has not been practicable to put the federal housing scheme in operation in that province. Commissioner C. J. Yorath states that the chief stumbling block in western Canada for the carrying out of a housing scheme is the fact that the provincial government intends to make any loans which may be advanced for this purpose part of the municipalities' debt. In the matter of town planning and control of municipal affairs Saskatchewan has perhaps the most advanced legislation in the Dominion. The Town Planning and Rural Development Act is administered by the Department of Municipal Affairs. The comprehensive nature of this act may be gathered from the following list of regulations which have been issued under it:—

Regulations Under Saskatchewan's Act

(1) Town Planning and Rural Development (Scheme) Procedure Regulations;

(2) Town Planning and Rural Development (By-law) Procedure Regulations;

(3) Regulations applicable to new development within the jurisdiction of municipalities which have not made regulations as authorized by section five of the Town Planning and Rural Development Act, and to new development in unorganized territory;

(4) Model regulations respecting new development for adoption by urban municipalities;

(5) Model regulations respecting new development for adoption by rural municipalities.

The object of the act is effectively to control the development of cities, town and rural municipalities. The importance of this being done is fully realized in Saskatchewan. Not only has the necessary legislation been obtained, but M. B. Weeks, Director of Surveys, has been appointed Director of Town Planning, and W. A. Begg, formerly Townsite Engineer for the Department of Highways, has been appointed Town Planning Engineer. The services of both will be available to local authorities to assist and advise in the preparation of schemes and development by-laws.

Conditions Similar in Alberta

The conditions regarding the housing scheme are the same in Alberta as in Saskatchewan and, consequently, no action is being taken to put the scheme in operation.

The preparation of town planning schemes for the larger cities is proceeding.

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*From "Conservation of Life," published by the Commission of Conservation, Ottawa.

THE KELLEY SYSTEM OF PAYMENT TO CONTRACTORS FOR ESTIMATING*

SINCE the "Nelson Plan" was conceived, other plans which contemplate payment for estimating have been proposed and put into operation. One of these which has received some attention, particularly in the middle west, is the so-called "Kelley Plan." This is a plan owned and controlled by "The National Contractors' Association, Inc.", a private corporation operated for profit, which acts (1) as organizer in keeping contractors in line as regards charging for estimates on a particular project, and (2) as agent for all contractors bidding on a project, in pooling and dividing the amount charged for estimating.

The plan derives its name from J. J. Kelley, president and chief stockholder of the "association." The chief elements of the plan are briefly as follows:—

Definite Schedule of Charges

A definite schedule of charges for estimating the cost of projects valued at from $2,000 to $1,000,000 or over has been established by Mr. Kelley. A contractor, party to the plan, submitting an estimate on a job, adds to his original estimate a sum equal to as many times the cost of estimating that job, as indicated by the schedule, as there are contractors party to the plan bidding on the job. Ordinarily, however, no contractor adds this amount to his bid unless all contractors bidding agree to do so. After the contract has been awarded and the job has progressed to a reasonable stage of completion, the successful contractor pays the total amount which he has added to his estimate, to the local agent of the "association." The agent divides that amount equally among the bidders, except 15%, half of which goes to the local agent and half to the "association" as commissions.

Contractors, party to the plan, must be "members" of the national "association." Membership dues were originally $10 for life; recently it has been announced that membership is free to any contractor, "general" or "sub," who will agree to adopt the schedule announced by the "association," add the proper amount to each estimate to which the plan is applied, and "divide up" with the unsuccessful bidders if he is awarded the contract.

For example:—Ten contractors, members of the "association," are bidding on a project approximating $75,000 to build. The average cost of estimating such a job has been set at $125. Each of the ten bidders then estimates the job in his own way and adds $1,250 to his bid, or ten times $125. After the contract has been awarded and the job has progressed to a reasonable stage of completion, the successful bidder pays $1,250 to the local agent of the "association." The agent gives each of the ten bidders $106.25, keeps $93.75 himself, and pays $93.75 to Mr. Kelley, of the national "association."

Results of Week's Operation

A further example of what this may amount to can be seen from the following figures, given by Mr. Kelley as the results of one week's estimating among "association" members in Toledo from March 16th, 1918, to March 23rd, 1918:—

Total received for estimating		$6,487.10
"Dues" in "National Association" for 19 members at $10	$ 190.00	
7½% commission to local agent	486.53	
7½% commission to Mr. Kelley	486.53	
85% returned to 19 members to cover cost of estimating in amounts varying from $51 to $1,095, average $280.21	$5,324.04	$6,487.10

In favor of the Kelley system are urged most of the arguments advanced in favor of any plan providing payment for estimating, especially that the owner thereby pays for estimates on his job only, that he can have just as many estimates as he is willing to pay for, and that the contractor thereby gets a fair fee for his professional services.

In contrast to the "Nelson Form" it has been urged by Mr. Kelley that his system encourages competition, which tends to reduce ultimate building costs 10%. An investigation of the operation of the system in one city in the middle west brought out the information that whereas formerly five contractors was the average bidding on work, since the Kelley system has been adopted, the average is nearer twenty.

Weakness in Kelley System

On the other hand, this very fact is urged against this particular system, and it is further stated that it encourages unscrupulous and irresponsible men to enter the field with the purpose of receiving sufficient bidding money to make a considerable profit on estimating without really contracting at all. Various elements in the Kelley system make this appear inevitable.

First, the contractor's fee for estimating is part of his bid on the job, which he controls and pays himself, rather than a separate fee paid by the owner for his services in estimating. This makes it possible for contractors to agree among themselves without the consent of the owner or the architect, to add to their bids a sum equal to the cost of estimating. So long as this is possible, there is bound to exist a tendency to do so secretly, and to "let in" on the job as many as are desired or "the traffic will bear."

With this possible, there is nothing to prevent an unscrupulous contractor from making a rough guess, high enough to insure his bid being rejected, add on the cost of estimating, and receive a share in the payment for estimating.

It is no case to state that the system is designed to be operated in co-operation with the architect and with the full approval of the owner, who would eliminate such a possibility, for, despite the good intentions of the originator and the honesty of most contractors, the actual facts show that the system falls down seriously at just this point.

Investigation in cities where the Kelley system is in operation shows that, while the number of bidders increases on some jobs because the architect is willing to pay for estimates, frequently it increases because he is unaware that he is being charged for the bids.

Accepted More Than Cost

A local agent in one city recently stated that the system did not work on a particular job where the owner took bids directly, as the contractors then had no means of finding out who was bidding in order to line everybody up, and apparently did not care to inform the owner of the plan. In another instance, where two of the announced bidders on a public contract failed to submit bids, their share of the total cost of estimating, instead of being returned to the state, was divided among the remaining bidders, showing clearly that the charge for estimating was being made without the knowledge of the engineer in charge, or else in collusion with him, to the detriment of the state. Where such secrecy is possible, excessive bidding by irresponsible contractors is also possible, and the whole system is thus brought into disrepute. This is the fundamental weakness of the Kelley system.

Other minor elements contribute to establish this fundamental weakness. According to the system, *all* or *none* of the bidders on a project must be party to the plan unless undue advantage is given those who do not include a charge for estimating in their bids. This makes it essential to employ a middleman, whose business it is to "line up" all the bidders on a project. The commission of this agent increases directly as the number of bidders increase. No matter how honest, therefore, may be the principles on which the plan is based, it is to the agent's advantage to increase the number of bidders, either as a party to the plan to charge for estimating secretly or in collusion with the owner's representative. The possibility and the actual existence of practices of this sort again bring the plan into disrepute.

*From a report of the "Committee on Methods" of the Associated General Contractors of America.

In answer to these objections, it is urged that the co-operation of the architect and the approval of the owner, if sought and gained in each instance, will remove all chance of excessive bidding. True; but it will also remove to a great extent all need for a middleman at a fancy commission. If recognition of the right to charge a fee for estimating is made by the architect or the owner, there is no reason for including the fee in the bid. If it is not included in the bid on the contract, it will not affect the total estimate, and hence it will no longer be necessary for *all* or *none* of the contractors to agree to charge for estimating. Thus will be removed the necessity for a middleman as organizer. If a fee is paid each contractor for estimating, there will be no necessity for the contractors to form a pool from which their payment may be made. Thus will be removed any necessity for a middleman as broker. Except, therefore, to educate small and irresponsible contractors in good business methods, there will be no need of special agents to make payment for estimating possible, once architects, owners and contractors see that it is desirable. Then if a system can be developed with the proper checks and balances, its adoption will be a matter of good business for all concerned.

Some General Considerations

To date, only the "Nelson Form" has proposed anything that would make the plan applicable to public work, which involves a reconciliation of the principle of free and open competition with payment for *all* estimates. If applied under the Kelley system, it must be applied secretly as noted above, or else the state would acknowledge no limit to the amount it would pay for estimates on any project. This is one of the most important and difficult problems involved in the whole situation, and one which deserves particular attention.

Another important consideration is the extension of the principle to the sub-contractors on a project where the general contractor submits the final estimate. Here again the "Nelson Form" is particularly interesting.

General contractors, in an effort to reduce their overhead costs, have been asking: "If an owner is willing to pay for plans and specifications in order that he may see how his ideas work out on paper, why should he not also pay contractors for the benefit of their experience and efforts in determining what it would cost to transfer these ideas on paper into a concrete structure?"

Since "the owner reserves the right to reject any and all bids," contractors frequently submit bids where the work does not proceed, and where no remuneration is thus paid anyone for the expense of bidding. On the other hand, while it is true that the cost of estimating is a legitimate overhead expense, it is likewise true that modern business methods teach the segregation of general overhead expense as closely as possible, and charge as many items as possible directly against the account where they belong. Applied to the expense of estimating, this means that each job should bear its full share of such cost.

With these views in mind, the "Committee on Methods" presents the following questions to general contractors and others interested, with the desire to secure as much advice as possible in formulating their conclusions on this problem:—

Questionnaire

1. Is estimating a service for which a fee should be charged, regardless of who gets the contract?

2. Is it fair to have owners of jobs undertaken pay costs of estimate (a) on projects which are not constructed, or (b) on jobs that his successful contractor has figured for other owners?

3. If selected architects are each paid for architectural competition, would a similar plan work for payment of bidding by selected contractors?

4. If this plan is not universally adopted, will not architects select contractors who do not endorse it to save these bidding fees, and thus possibly eliminate the chances of the latter on such work?

5. Should payments for bidding be based on the lowest bid submitted if work is not awarded; on the accepted bid if awarded; or on what basis?

6. If payment for bidding is appropriate and possible for building work, is it also feasible for railroad work or industrial work let on the unit price basis?

7. Should bids submitted be so itemized as to permit the owners to trade on same to competitors, and thus take possible undue advantage?

8. How many alternates should be included in bids submitted under a plan of payment for estimating?

9. Should bids be opened publicly?

10. Should payments for bidding be made only when all bids are rejected?

11. Should not cubic feet and square feet estimates be included for payment, as competitors otherwise might work out detailed estimates first and then convert same into above units?

12. What provision should be made for re-figuring altered plans?

13. How will each contractor know that another contractor is charging and insisting upon payment of his fee? Is it essential?

14. If this plan is proper for general contractors, shall general contractors extend the same practice to their sub-contractors? How?

15. Will publication of a plan in current technical periodicals bring satisfactory answers; should the letter ballot plan be adopted among responsible contractors; how should a plan be put into operation?

16. Is this plan of duplicate cost of bidding really the most economical for the industry, or should one quantity surveyor be employed by the owner and no charge for pricing such survey then be made by the contractors?

17. What plan do you believe should be advocated for the best service to the public?

PROPOSE DAM ACROSS BELLE ISLE STRAITS TO CHANGE NEWFOUNDLAND'S CLIMATE

"NEWFOUNDLAND is contemplating changing its climate," states a despatch from St. Johns, Newfoundland, recently published in a large number of daily newspapers.

"The climate of Newfoundland would be changed if a breakwater were built across the Straits of Belle Isle, between the island and the mainland, and the cold Labrador current were shunted out into the Atlantic Ocean. Such a dam is being seriously considered. It would cost an immense sum of money but engineers say it presents few difficulties.

"The Labrador current at present is the chief factor in moulding the climate, not only of Newfoundland, but of the Maritime Provinces and New England. Coming down from the Arctic Ocean it pours through the Straits of Belle Island, and, circulating around the Gulf of St. Lawrence, washes with its cold flood the coasts of Newfoundland, Quebec, New Brunswick and Nova Scotia. Then, passing through Cabot Strait, it turns south and sweeps along New England. Its strong southward flow acts as a cold wedge which pries the Gulf Stream away from all these coasts and shunts that ocean river, bearing the warmth of the tropics, off north-eastward across the ocean.

"If the Belle Isle dam is built, the Labrador current would be blocked out of the Gulf of St. Lawrence and, shearing off south-east, would miss the mainland and continue to affect only the north-eastern coast of Newfoundland. The Gulf Stream then would ease in against the continent and, flowing into the Gulf of St. Lawrence, warm all the surrounding shores and islands.

"The Gulf Stream is responsible for the mild winter climate of England and northern France. England is farther north than Newfoundland. If, after cooling off in its long passage across the northern seas, the Gulf Stream is still such a factor in tempering England's climate, it would have an even greater effect, it is believed, in tempering the winter climate of Eastern Canada and New England."

Operation of Slow Sand Filters at Toronto

Ten Thousand Samples Tested During Year 1918 Show 99.7% Average Reduction in B. Coli, 99.1% in Total Bacteria, and 99% in Excremental Bacteria—Pollution of Raw Water Increased 61.9% in Five Years Judged by B. Coli Tests

By NORMAN J. HOWARD

Bacteriologist-in-Charge, Filtration Plant Laboratory, Toronto

THE water supply for the city of Toronto is drawn out of Lake Ontario, the intakes being situated a little more than 2,000 feet due south of the plant. Filtration is effected by means of two modern installations, one being a mechanical plant of the drifting sand type, and the other a slow sand system. As the mechanical plant is being made the subject of a special report, it is proposed to deal only with the slow sand system for the period of twelve months ending December, 1918.

Out of 15,880 samples examined in the laboratory, either chemically, physically, microscopically or bacteriologically, some 10,000 were from the slow sand system.

Bacteriological Results

Tests for the enumeration of bacteria growing on agar and rebipelagar at blood temperature, and for the isolation of the colon bacillus were made on the raw and filtered water throughout the year. The average number of bacteria per c.c. growing on nutrient agar for twenty-four hours at blood temperature was 356.3 in the raw water and 2.2 in the filtered water, a reduction of 99.1 per cent. Excremental bacteria growing under the same conditions showed that the raw water contained 26.5 and the filtered water 0.25 per c.c., respectively, giving a reduction of 99 per cent. The media used in test was neutral red, lactose bile-salt, peptone agar,

TABLE A

Number of Examinations Made During the Year

Month	Bacteriological	Physical and Microscopical	Chemical
January	660	447	169
February	579	374	124
March	614	425	143
April	704	510	162
May	699	426	136
June	638	532	135
July	735	451	155
August	686	549	187
September	661	545	160
October	644	664	201
November	678	581	167
December	590	533	167
Total	7,888	6,037	1,906
Total			15,831

Special Examinations

Aluminium Sulphate	26
Boiler Incrustations	3
Boiler Compounds	2
Trap Rock	3
Copper and Brass	12
Cement	3
Total	49
Grand Total	15,880

Examinations made in 1912	8,096
" " " 1913	9,382
" " " 1914	9,848
" " " 1915	10,292
" " " 1916	12,076
" " " 1917	15,041

as used by Dr. A. C. Houston, of the Metropolitan Water Board, London, Eng. For the isolation of the colon bacillus, lactose ox gall was used. The raw water showed the colon bacillus to be present in one cubic centimetre on 121 days (39.9 per cent.). The average indicated number of B. Coli present in the raw water was 11.36 per c.c., whilst the filtered water contained .027 per c.c. The total percentage removal of the colon bacillus in the filtered water was 99.7. Reference to table D will show the complete figures covering the colon tests for the past six years.

Physical examination of the water was made daily, and showed that, whilst the turbidity varied considerably in the raw water, ranging between 1 to 160 parts per million, the filtered water was at all times free from turbidity, the effluent being clear, bright and sparkling. The microscopical examination was not carried out as frequently or as thoroughly as in previous years, due to the extra laboratory work involved by the new mechanical plant. Nevertheless, the observations made at the different seasons of the year were extremely valuable, and often threw light on the fluctuation in the loss of head of the filters, which otherwise would have been difficult to understand.

Amongst the many types noted were the diatoms cymbella, cocconeis, navicula gracilis, stauroneis, epithemia,

TABLE B

Bacteria growing on Agar at 37-39 degs. C., 24 hours incubation, showing monthly maximum, minimum, and average number per c.c. in raw and filtered water; yearly average number per c.c. in raw and filtered water, and the total percentage reduction in the filtered water for the year.

Month.	Raw Water Maximum	Raw Water Minimum	Raw Water Average	Filtered Water Maximum	Filtered Water Minimum	Filtered Water Average
Jan.	550	0	50.4	5	0	.96
Feb.	280	0	27.6	3	0	.87
Mar.	320	1	37.8	6	0	.32
Apr.	970	0	139.0	6	0	.76
May	1,800	1	114.0	6	0	1.36
June	1,340	0	195.46	14	0	1.83
July	620	0	110.23	5	0	.96
Aug.	3,800	16	654.27	46	0	2.96
Sept.	2,200	1	564.2	25	0	3.5
Oct.	17,200	8	1,466.6	30	0	5.6
Nov.	3,825	2	389.2	12	0	3.5
Dec.	1,850	2	573.35	7	0	2.4
Average for year	.	.	356.3	.	.	2.2

Total reduction for the year, 99.1 per cent.

himantidium, asterionella, synedra, fragilaria, diatoma, tabellaria, nitzschia sigmoida and longissima, melosira, cyclotella, stephanodiscus, the cyanophyceae microcystis, coelosphaerium, anabaena, the chlorophyceae palmella, tetraspora, scenedsmus, hydrodicton, sorastrum, volvox, ulothrix, the protozoa actinophrys, uroglena, dinobryon, ceratium, vorticella, codonella, coleps, and several types of rotifera, crustacea, and infusoria. There were many other varieties which were not identified. Many of the above mentioned when present are known to be objectionable on account of their imparting a taste or smell to the water. During the summer months, when the water was warm, particularly during August and September, a faint taste appeared to be present in the raw water. The filtered water was practically free from organisms; occasionally there was a trace of amorphous matter, but the taste previously mentioned, whilst considerably lessened, was not completely eliminated. It is doubtful if the taste was noticed by the consumer.

Chemical Examination

Considerable time was devoted to the chemical examination of the raw and filtered water. The test for the determination of ammoniacal nitrogen is practically the only known test for ascertaining rapidly the condition of the raw water. On many occasions this information was most useful in the operation of the filters. The general reduction of the organic matter in the filtered water was satisfactory, the free and albuminoid nitrogen and the oxygen consumed showing substantial reductions. The nitrates increased, pointing to oxidation caused by nitrifying bacteria on the surface of the filters. A further increase in the chlorides cannot be regarded as satisfactory, and is another indication of the degree of pollution that is yearly increasing.

The rate of filtration for the year was 3.27 million Imperial gallons per acre per day, this being slightly lower than in the previous year. The total amount of water filtered was 11,470 million Imperial gallons. In the yearly report for 1916 special reference was made to the quality of the sand, particularly as regards the effective size and the uniformity coefficient. At that time the portable sand washer was being used in the summer months. This practice was discontinued and the washer is now used only during the winter months. The quality of the sand greatly improved during 1918 and is now in good condition.

TABLE C

Excremental bacteria growing on Bile-Salt Agar (Rebipelagar) at 37-39 deg. C., 24 hours incubation, showing monthly maximum, minimum and average number per c.c. in raw and filtered water; yearly average number per c.c. in raw and filtered water, and the total percentage reduction in filtered water for the year.

Month.	Raw Water			Filtered Water		
	Maximum	Minimum	Average	Maximum	Minimum	Average
Jan.	188	0	11.1	2	0	.2
Feb.	80	0	4.4	2	0	.126
Mar.	164	0	13.3	4	0	.32
Apr.	300	0	40.8	1	0	.16
May	57	0	8.6	6	0	.44
June	170	0	29.58	8	0	.5
July	27	0	2.65	2	0	.08
Aug.	270	0	16.73	1	0	.08
Sept.	86	0	12.8	10	0	.5
Oct.	1,250	0	91.62	1	0	.12
Nov.	29	0	6.12	1	0	.08
Dec.	440	0	73.2	3	0	.58
Average for year.	...	.	26.5	.	.	0.25

Total reduction for the year, 99.0 per cent.

Summary

(1) Over 10,000 samples were examined from the slow sand system during the year.

(2) The average number of bacteria growing on agar at blood temperature was 356.3 per c.c. in the raw water and 2.2 per c.c. in the filtered water. Total reduction, 99.1%.

(3) The average number of excremental bacteria growing on bile-salt agar at blood temperature was 26.5 per c.c. in the raw water and 0.25 per c.c. in the filtered water. Reduction, 99.0%.

TABLE D

Monthly Percentage of Samples Showing B. Coli in Raw and Filtered Water

Month	Raw Water						Filtered Water			
	100cc	10cc	1cc	.1cc	.01cc	.001cc	100cc	10cc	1cc	0.1cc
Jan.	76.0	40.0	32.0	12.0	0.0	0.0	19.0	4.0	0.0	0
Feb.	100.	66.6	16.5	0.0	0.0	0.0	75.0	29.8	0.0	0
Mar.	96.0	52.0	28.0	8.0	0.0	0.0	88.0	24.0	4.0	0
Apr.	96.0	80.0	48.0	20.0	0.0	0.0	88.0	24.0	0.0	0
May	96.1	57.7	30.8	7.7	0.0	0.0	53.8	11.5	0.0	0
June	95.8	50.0	41.6	8.3	0.0	0.0	29.1	0.0	0.0	0
July	92.3	61.5	23.0	7.7	0.0	0.0	30.8	3.8	0.0	0
Aug.	100.	96.1	66.4	26.9	7.7	0.0	50.0	11.5	0.0	0
Sept.	100.	75.0	50.0	20.8	4.2	0.0	45.8	8.3	0.0	0
Oct.	96.1	76.9	53.8	30.8	7.7	0.0	61.5	15.3	0.0	0
Nov.	96.1	60.0	28.0	7.7	0.0	0.0	38.4	11.5	0.0	0
Dec.	92.0	88.0	68.0	36.0	28.0	8.0	92.0	60.0	4.0	0

Efficiency as Judged by B. Coli Test, Showing Percentage Reduction in Filtered Water.

100cc., 36.0%; 10cc., 74.0%; 1cc., 98.3%; 0.1cc., 100%; 0.01cc., 100%; 0.001cc., 100%.

Indicated Number of B. Coli per 100cc., and 1cc.

Average of 302 samples: Raw water, per 100cc., 1,136; per 1cc., 11.36. Filtered water, per 100cc., 2.7; per 1cc., .027.

Total reduction of B. Coli in Filtered Water, 99.7%.

Total Percentage of Samples Showing B. Coli in Raw and Filtered Water During Past Six Years

Year	Raw Water						Filtered Water			
	100cc	10cc	1cc	0.1cc	0.01cc	0.001	100cc	10cc	1cc	0.01cc
1913	81.2	54.6	24.6	4.9	0.0	0.0	33.2	7.6	0.3	0.0
1914	87.4	61.0	30.7	8.6	0.99	0.0	36.2	8.9	1.3	0.0
1915	91.4	60.2	31.9	8.2	1.6	0.3	46.4	11.1	1.7	0.0
1916	96.4	68.7	35.8	10.5	0.98	0.0	56.9	11.5	0.65	0.0
1917	92.7	67.1	32.2	8.5	2.6	0.0	59.8	14.4	0.32	0.0
1918	94.7	66.2	40.0	15.5	3.9	0.66	60.6	17.2	0.66	0.0

(4) The total percentage of samples showing B. Coli in one c.c. was 39.9 in the raw water and 0.66 in the filtered water.

(5) The average indicated number of B. Coli present per 100 c.c. of water examined was 1,136 in the raw water and 2.7 in the filtered water, showing a total reduction of 99.7%.

(6) Pollution of the raw water as judged by the B. Coli test has increased by 61.9% since 1913.

(7) The highest temperature recorded in the water was 64 degs. F. and the lowest 33.9 degs. F.

(8) The highest degree of turbidity occurring in the raw water was 160 p.p.m., whilst the lowest was 1. The filtered water was free from turbidity throughout the year.

(9) The chlorides in the raw water were 8.2 p.p.m. in 1913, whilst in 1918, the figures had increased to 9.89 p.p.m.

(10) The total number of filters cleaned during the year was 181.

(11) The average rate of filtration was 3.27 million Imperial gallons per acre per day.

TABLE E

Average Monthly Turbidities, Showing Maximum and Minimum Figures

Month	Raw Water			Filtered Water		
	Maximum	Minimum	Average	Maximum	Minimum	Average
January	24	1	4.0	0.5	0.5	0.5
February	39	1	4.0	0.5	0.5	0.5
March	61	1	8.3	0.5	0.5	0.5
April	160	1	26.5	0.5	0.5	0.5
May	7	1	2.0	0.5	0.5	0.5
June	7	1	1.7	0.5	0.5	0.5
July	3	1	1.6	0.5	0.5	0.5
August	8	1	1.8	0.5	0.5	0.5
September	14	1	2.9	0.5	0.5	0.5
October	7	1	1.6	0.5	0.5	0.5
November	12	1	1.9	0.5	0.5	0.5
December	65	1	18.7	0.5	0.5	0.5

(12) The average amount of water filtered was 31.42 million Imperial gallons, or 50% of the average amount of water daily consumed.

(13) *The maximum and minimum consumption daily during the year was 77.49 and 45.61 million Imperial gallons, respectively, whilst the average daily consumption was 62.72 million Imperial gallons.

(14) *The average daily consumption per capita was 128 Imperial gallons.

Conclusions

For several years past attention has been directed to the continual deterioration in the quality of the raw water. Observations were based upon the percentage number of days in the year that the raw water contained the typical colon bacillus in one cubic centimetre of water examined. The figures for the past six years which read as follows: 1913, 24.6%; 1914, 30.7%; 1915, 31.9%; 1916, 35.8%; 1917, 32.2%; 1918, 39.9%, show conclusively that the raw water is becoming impurer. The slight reduction in 1917 was due to the more favorable weather rather than to any improvement in the quality of the water.

In 1913 the colon bacillus was present on seventy-five days (24.6%) of the total number of days upon which examination of the raw water was made. This figure had increased in 1918 to 121 days (39.9%). From the figures submitted it will be seen that the pollution in the raw water was progressive in character, and that the actual percentage increase in the number of days upon which the water was seriously polluted had increased 61.9% in six years. The normal increase in population and the consequent discharge of sewage into the lake may have been the principal rea-

TABLE F

Temperatures of Air and Water in Degrees Fahrenheit at 9.30 a.m.

Month	Water			Air		
	Maximum	Minimum	Average	Maximum	Minimum	Average
January	37.0	32.0	34.7	33	–8	12.29
February	36.0	33.0	34.8	39	–15	21.7
March	35.9	32.9	33.9	46	14	32.6
April	39.2	33.8	36.6	49	28	40.3
May	44.6	37.4	40.6	68	40	50.42
June	50.0	41.0	44.3	70	52	60.1
July	46.4	41.0	43.9	78	51	66.5
August	64.0	41.0	66.9	76	55	67.0
September	60.8	41.0	47.0	66	42	64.8
October	50.0	41.0	45.1	68	41	48.9
November	50.0	42.0	45.4	55	24	42.3
December	42.0	36.0	38.6	44	18	33.2

*Figures kindly supplied by Department of Works.

son for this. This applies not only to Toronto, but to the many cities, towns and municipalities in the vicinity which are daily discharging enormous quantities of sewage into the lake. With the exception of the city of Toronto, little attempt is being made to treat the effluents so as to render them innocuous. As far back as 1912 (city engineer's report) it was clearly shown that the water of Lake Ontario was polluted by currents some seven miles out from the intakes. When these conditions are taken into consideration, together with the various pollutions arising from marine traffic, dredging operations, spring freshets and the frequent pollution following summer storm floods, it will be seen that the contributory causes are numerous. Probably there are no cities on the great lakes where the pollution of the raw water in the immediate vicinity is not yearly increasing, regardless of the steps taken to prevent the discharge of putrescrible matter into the rivers or lakes involved, those responsible for the purification of water supplies depending upon filtration for clarification and chlorine for final sterilization.

While the occurrence of pollution in the raw water is yearly increasing, the degree of pollution is intensifying. As has been the case for several years past, the most serious pollution occurred in the summer and fall months. On forty-seven days the raw water contained the colon bacillus in 1/10th part of one cubic centimetre, on twelve occasions in 1/100th part, and on two occasions in 1/1000th part of one cubic centimetre. Assuming that crude sewage contains at least 100,000 B. Coli per c.c. the last two figures showed the raw water to contain a pollution equivalent to 1,000 and 10,000 parts of sewage, respectively, to each million gallons of water.

TABLE G

Average Monthly Chemical Figures: Results Expressed in Parts Per Million Raw Water

Month	Ammoniacal Nitrogen Free	Albuminoid	Total	Nitrates	Chlorides	Oxygen Consumed 4 hours at 80° F.	Oxygen Dissolved	Alkalinity as CaCO3
Jan.	.009	.073	.082	....	9.64	.45	.....	.....
Feb.	.005	.074	.079	....	9.63	.44	13.21	93.35
Mar.	.020	.082	.102	....	.....	...	13.49	92.20
Apr.	.018	.084	.102	....	.....	...	13.46	94.05
May	.013	.079	.092	....	.....	...	13.28	95.80
June	.007	.073	.080	.069	10.17	.49	12.92	94.15
July	.003	.077	.080	....	10.10	.56	12.97	94.25
Aug.	.007	....	....	.065	.....	...	11.41	96.20
Sept.	.008	....	....	.020	10.05	.66	11.35	93.70
Oct.	.021	.069	.090	.093	10.04	.54	11.67	94.88
Nov.	.007	.051	.058	.040	9.57	.45	11.39	94.30
Dec.	.036	.037	.063	.013	.....	...	12.16	94.80
Average	.013	.070	.083	.050	9.89	.51	12.48	94.24
Filtered Water								
Jan.	.001	.048	.049	....	9.6	.29	.....	.....
Feb.	.001	.051	.052	....	9.6	.30	12.80	93.26
Mar.	.001	.051	.052	....	...	...	.....	91.92
Apr.	.001	.049	.050	....	...	...	.....	94.00
May	.001	.048	.049	....	...	...	.....	.....
June	.001	.038	.039	.109	10.17	.29	.....	94.55
July	.001	....	....	.083	10.10	.41	.....	95.28
Aug.	.001	....	....	.080	.....	...	.....	95.05
Sept.	.001	....	....	.070	10.00	.43	10.10	.....
Oct.	.001	.032	.033	.098	10.04	.32	10.38	96.74
Nov.	.001	.027	.028	.078	9.55	.31	10.16	95.44
Dec.	.001	.023	.024	.040	.....	...	11.63	93.60
Average	.001	.041	.042	.080	9.87	.34	11.01	94.41

Per Cent. Purification Figures

Ammoniacal Nitrogen Free	90.6%	Reduction
Albuminoid	41.9%	"
Total	49.4%	"
Oxygen consumed	34.4%	"
Nitrates	59.2%	Increase

Chlorides and Alkalinity showed little change.

Final Sterilization Always Necessary

The daily examination showed the raw water to be subject to a continuous and increasing degree of pollution, which condition was almost entirely controlled by the meterological conditions prevailing at the time. From this it would seem desirable that early action should be taken to treat sewage that is being discharged into the lake, so that the effluents are rendered innocuous. The remarkable figures obtained by filtration reduced very materially the degree of pollution previously mentioned as occurring in the raw water, and show that the actual results achieved by filtration alone would almost have rendered the water fit for consumption without final sterilization, but it must be remembered that a water that is initially polluted with matter of excremental origin can never be filtered so efficiently as to render it innocuous. For instance, if a water before filtration contained 5,000 bacteria per cubic centimetre and filtration removed 99.5%, there would still be twenty-five remaining, some of which might belong to the pathogenic group, which, if of a virulent nature, might be capable of causing a serious epidemic. The necessity of final sterilization then becomes apparent. Throughout the year the figures obtained by filtration showed splendid efficiencies equalled by few plants on the American continent. At present Toronto is fortunate in having a water supply that is both filtered and chlorinated. The excellent system of chlorination is directed by Col. Geo. G. Nasmith, Director of Civic Laboratories, and consequently the water as finally delivered to the consumers is splendid, being clear, bright and of high bacterial quality.

TABLE H.—FILTER OPERATION

Average Rate of Filtration for the Year.—3.27 million Imperial gallons per acre per day.
Total Amount of Water Filtered.—11,470 million Imperial gallons.
Maximum and Minimum Amount of Water Filtered in 24 hours.—Maximum, 40.04; minimum, 18.58 million Imperial gallons.
Average Amount of Water Filtered Daily.—31.42 million Imperial gallons.
Number of Filters Raked or Cleaned.—181.
Filter runs, length of runs in days completed during each month, showing maximum, minimum and average figures, and yield per run in million Imperial gallons per acre.

Month	Maximum	Minimum	Average	Yield Per Run Per Acre
January	42	1	20.7	75.368
February	50	7	26.5	99.96
March	46	8	30.0	116.20
April	35	13	20.9	77.56
May	38	8	28.2	106.55
June	33	3	21.2	78.36
July	24	5	17.1	66.91
August	30	7	18.1	68.67
September	25	3	19.1	70.42
October	35	15	25.1	86.86
November	32	13	23.2	73.37
December	39	2	19.4	65.04

The name of the firm of Brennan and Hollingworth, contractors, Hamilton, Ont., has been changed to the W. C. Brennan Contracting Co.

A good roads association has been organized at Chilliwack, B.C. Following are the officers: Hon. presidents, F. B. Stacey, M.P., Hon. E. D. Barrow, M.L.A., Mayor Ashwell and Reeve Evans; president, W. L. Mackin; vice-president, E. H. Barton; secretary, W. R. Theal; treasurer, G. O. Nesbitt.

The New England Water Works Association will hold its annual convention September 30th to October 3rd, inclusive, in Albany, N.Y. The preliminary program, which will be published in full next week, includes a paper by Norman J. Howard, of Toronto, on the "Operation of and Purification Effected by the New Drifting Sand Filter System at Toronto." The president of the association is S. E. Killam, superintendent of pipe lines and reservoirs of the Boston, Mass., Water Works. The secretary is Williard Kent, civil engineer, Narrangansett Pier, R.I.

The Greater Winnipeg Water Board has decided to wait until next spring before proceeding with the work of underdrainage for a section of the Shoal Lake aqueduct. It is estimated that this work will cost $330,000. It is necessitated by the alkali waters in the soil surrounding one section of the aqueduct. The proposed pipe line to Transcona will likely be built this fall, the councils of all the municipalities interested having tentatively agreed upon the extension. It is likely that the price of 2c. per 1,000 gals., which is now being charged, will be reduced to 1¼c., as the Board has recommended this reduction, claiming that it has found that the water can be sold without loss at the lower rate. All the municipalities interested have not yet agreed to the reduction, so it is being held in abeyance for the time being.

CANADIAN ENGINEERING STANDARDS ASSOCIATION

Visit from Secretary of the British Association—Appointment of Committees and Sub-Committees—Report to be Prepared on Standard National Electric Code

At a meeting of the main committee of the Canadian Engineering Standards Association, held September 8th, H. H. Vaughan presiding, the following new members were appointed:—

J. M. R. Fairbairn, nominated by the Canadian Pacific Railway; H. H. Kelley, nominated by the Grand Trunk Railway; A. F. Stewart, nominated by the Canadian National Railways; F. A. Gaby, nominated by the Hydro-Electric Power Commission of Ontario; A. A. Dion, nominated by the Canadian Electrical Association; and J. Stadler, nominated by the Canadian Pulp and Paper Association.

The lists of members for the following sectional committees were approved:—

Electrical sectional committee, Dr. L. A. Herdt, chairman.

Sectional committee on steel bridges and construction, G. H. Duggan, chairman.

Sectional committee on wire rope, Prof. H. M. Mackay, chairman.

Recommendations as to membership of the following sub-committees were received, and the committees appointed accordingly:—

Sub-committee on steel railway bridges, P. B. Motley, chairman.

Sub-committee on incandescent lamps, John Murphy, chairman.

Sub-committee on transformers, A. A. Dion, chairman.

The secretary reported the progress made with regard to various questions already under consideration, and further reported a number of requests for action on the part of the association. Several of these were approved for further enquiry and report.

The chairman welcomed C. Le Maistre, the secretary of the British Engineering Standards Association, who is now on a visit to Canada and the United States. Mr. Le Maistre described briefly the work of the B.E.S.A., and drew the attention of the committee to certain matters in which his association would welcome the assistance and co-operation of the Canadian Engineering Standards Association, referring especially to proposals which have been made with a view of obtaining some degree of Anglo-American agreement as to screw thread standards. Mr. Le Maistre further pointed out the desirability of international agreement as to rules affecting electrical appliances and fittings, particularly for interior use.

As regards the first suggestion, it was decided to appoint a sub-committee on screw-threads, with instructions to consider and report on Mr. Le Maistre's communication.

Considerable discussion took place on the question of rules for electrical appliances, and the committee agreed that the formulation of a "Canadian Electric Code" was most desirable. The committee then directed that a sub-committee should be called together to enquire and report further as to this point.

H.R.H. the Prince of Wales unveiled commemorative tablets on the Quebec bridge during his recent visit at Quebec. These tablets bear the names of the engineers chiefly responsible for the successful completion of the bridge.

Regina's Board of Trade favors the proposed pipe line from Elbow, Sask., for supplying Regina and Moose Jaw with Saskatchewan river water. A committee has been appointed to interview the provincial government.

A. C. Grant, of the Grant Construction Co., has asked Toronto's city council to excuse him from carrying out his contract to lay a concrete roadway on Keewatin Ave., North Toronto. Mr. Grant complains that he cannot obtain labor even at fifty cents an hour and carfare. He states that he also has a contract in Brampton, Ont., which he will not be able to complete this year for the same reason.

THE BEAR RIVER BRIDGE

(Continued from page 312)

then begun with an orange-peel bucket, through a well in the centre of the dam. As the cofferdam went down, it was built up to keep the top above low water level. The position of the cutting edge was determined daily by obtaining the levels of four points on the dam equidistant from the cutting edge, and the dredging was directed accordingly to keep the dam vertical.

This was quite successful until a depth of 12 ft. had been obtained, when one side of the dam got hung up on a large boulder, with the result that the dam took a list of about 15 degs. from the vertical.

Divers were then sent down to direct water jets around the obstructions and dredging was carried on the outside of the dam on the high side. Finally the dam was straightened up into its correct position at a penetration of about 28 ft. and resting on a bed of coarse gravel and boulders. The total height of the dam is 62.4 ft. containing 130,000 ft. of timber and 1,473 cu. yds. of concrete.

Pier 4, the pivot pier, was sunk in similar manner to the depth of 36 ft. and contains 175,000 ft. of timber and 19,000 cu. yds. of concrete. Pier 5 was sunk to a depth of 40 ft. and contains 142,000 ft. of timber and 1,453 cu. yds. of concrete.

Under-Water Pile Driving

At piers 6 and 7, where the boring showed a considerable depth of mud, it was decided to excavate about 15 ft. and drive piles. After the excavation was complete, there was a depth of 35 ft. of water at low water, and the under-water method of driving piles was introduced.

This method caused considerable discussion on the work, some claiming that it would develop at least 85% efficiency as compared with the ordinary method of driving piles with a drop hammer. I may here say that the average penetration with the under-water method was only about one-half of what was obtained at the same location with a lighter hammer falling through air. In the under-water method, the guide pile and hammer were handled by a stiff derrick operated by a 25 h.p., 3-drum hoist. The guide, constructed of four 3½-in. steel angles, latticed together, was 22 in. sq., inside measurement, and all rivets were sunk on the inside. It was made in 15 ft. sections, capable of being bolted together to give the required length. Lugs riveted to the top section rested on crossed timbers on the cofferdams, and the guide hung therefrom, just clear of the bottom of the excavation and over the spot where the pile was to be driven.

The pile was then inserted in the guide and allowed to drop to the bottom. With heavy piles, as much as 10 ft. penetration was obtained in some cases right at the start. The hammer weighing about 5,000 lbs., was built to give a clearance of about ¼ in. all round inside the guide, and terminated in a truncated pyramid. The hammer was lowered into the guide after the pile and driving commenced, a fall of from 12 to 15 ft. being given. The fall was thus limited, as it was found that the pile heads broomed badly.

Prevented Interruption of Work

The piles used were exceptionally good, but many of them failed to stand up under this treatment. The maximum penetration obtained was 46 ft., whilst test piles, driven from the same location from a scow with a 24,000 lb. hammer and a trolly, gave a penetration of 65 ft.

However, the big advantage of being able to drive under water was that the work could go on at all stages of the tide, and this meant that at high water the driving was being done through 70 ft. of water. The condition of the old bridge was such that anything within reason which would hasten completion of the new could not be neglected.

The length of the bridge is 1,640 ft. The total amount of concrete used was 13,000 cu. yds. The contractors for the abutment and for piers 1 and 2 and 8 to 14 inclusive were Powers & Brewer, of St. John; for piers 3 to 7 inclusive, the Foundation Co., Ltd., of Montreal. G. G. Hare was the engineer for the Dominion Atlantic Railway, and the writer was resident engineer.

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EFFICIENCY, PRODUCTION AND CONSERVATION CANADA'S NEEDS OF THE HOUR

CONSERVATION of material, in order to assist in national reconstruction, must find expression in the following eight measures, says a writer in the last issue of "Conservation," the official bulletin of the Commission of Conservation:—

(1) Increase the fertility of the soil and reclaim areas not under cultivation at present.

(2) Protect our forests from fire and reforest denuded areas.

(3) Guard certain species of fish and wild life against extinction.

(4) Exploit our mines conservatively, extracting the maximum output of ore.

(5) Develop our potential resources of hydro-electric power.

(6) Organize our manufactures to secure maximum efficiency and to recover by-products.

(7) Eliminate extravagance in consumption.

(8) Find an economic use for materials now treated as refuse.

This is a succinct statement of a very comprehensive program, and one that must be followed if Canada is to hold her own in the economic struggle. The second phase of conservation necessary for efficiency during the reconstruction period, is conservation of our human resources. As pointed out by the Commission of Conservation, work under this heading must include:—

(a) Efficiency in public hygiene and sanitation.

(b) Sound town-planning schemes and improved housing.

(c) Better roads and better organization of all systems of transportation, so that products may be conveyed from producers to consumers with minimum effort and expense.

Some of this work is beyond the jurisdiction of the Commission of Conservation, but that commission is performing useful service in repeatedly calling the attention of the public to basic requirements. With the active co-operation of the newly-organized departments of Public Health and Public Highways, the good work of the Commission of Conservation will be given a great impetus.

ONTARIO HIGHWAY AWARDS RESCINDED

TWO weeks ago the Department of Public Highways of the Province of Ontario announced the award of four contracts for the construction of 50 miles of the provincial highway; yesterday the deputy minister in charge of the department rescinded the awards and stated that the contracts would not be signed. The reason given is that the lowest tenders received were 50% higher than expected.

The specifications called for bituminous construction, penetration method. The lowest bid received for any section was $32,000 a mile; for another section the lowest bid was $40,000 a mile; while for the other two sections the lowest bids ranged between those two figures. These prices were exclusive of the cost of culverts.

W. A. McLean, deputy minister of the department, declares that the work will be carried out by day labor, and that a great saving will thereby be effected. The department, says Mr. McLean, pays labor 30 to 35 cents an hour, while contractors offer 45 to 55 cents in order to persuade men to enter their employment at once. "Time is more important to the contractor than to the province," says Mr. McLean. "The contractor loses money if he cannot finish the work quickly. The province can wait and engage men from the farms whenever they are willing to work for the wages offered. The fact that the province's plant is tied up for a long period is not considered to be a serious factor, whereas a contractor must keep his plant in more or less constant use."

The fact that the awards have been rescinded does not mean that the roads will not be built, says Mr. McLean, but they will be built at a slower rate and by provincial forces, but, he prophesies, at less expense. The change in policy regarding these awards involves more than the question of day labor vs. contracts, as Mr. McLean intimates that the department may construct water-bound macadam and gravel roads at first and may not surface them in any more permanent manner for a few years. That is, cheaper roads may possibly be built with the intention of using them, after consolidation by traffic, as foundations for more expensive types of construction such as asphaltic or tar macadam or cement-concrete. Mr. McLean states that the better types of surfacing will be laid as soon as the macadam has fully settled and that meanwhile the roads will be well oiled.

FAIR PLAY FOR THE G.T.R.

AS the pioneer railroad of Canada, the Grand Trunk Railway is entitled to the benefits of arbitration in establishing a fair price for its assets and prospects. Conferences are now being held in Ottawa by the prime minister of Canada, Sir Robert Borden, and the chairman of the G.T.R. directorate, Sir Alfred Smithers, and it is thought that the result may be mutually satisfactory without recourse to either litigation or arbitration. Should unforeseen difficulties be encountered, the G.T.R. should agree to a reasonable minimum payment and the government should agree to arbitrate, as there appears to have been a difference of more than $4,000,000 per annum between the G.T.R.'s earlier claims and the rental which the government offered in the first negotiations. The old G.T.R. deserves fair play.

PERSONALS

WILLIAM GORE, consulting engineer on the staff of the John ver Mehr Engineering Co., Ltd., Toronto, has tendered his resignation to that company in order to become a member of the new consulting firm of Gore, Nasmith and Storrie. Mr. Gore was born April 13th, 1871, at King's Lynn, Norfolk, Eng., and received his preliminary education at the King's Lynn Technical School. From 1888 to 1892 he was an articled pupil at the Highgate Iron Works, King's Lynn, and for the following two years was assistant engineer at that plant. In 1893 he won the Norfolk County Council scholarship and in 1894 the Witworth Exhibition scholarship, and entered the mechanical engineering course at the Technical College of the City and Guilds Institution of London, Eng., where he graduated in 1896. For more than a year after graduation, Mr. Gore was chief draftsman of the Western Electric Co., of Woolwich. In 1897 he joined the staff of the late George F. Deacon, consulting water works engineer, and was the latter's chief assistant until 1909, when, upon Dr. Deacon's death, the business was taken over by Sir Alexander Binnie. From 1897 to 1912 Mr. Gore had experience on many large water supply, sewerage, irrigation and hydro-electric projects in various parts of the world, including Great Britain, Russia, Italy, Greece, India and Australia. During that time he designed and constructed a considerable number of masonry dams. In 1912 Mr. Gore completed the invention of what is now known as the Ransome drifting sand filter, and joined the Ransome-ver Mehr Machinery Co., of London, Eng., for the purpose of developing that system of water filtration. When tenders were called in 1913 for a new mechanical filtration plant for the city of Toronto, the London company incorporated a Canadian branch, the John ver Mehr Engineering Co., Ltd., of Toronto, and obtained the contract for the construction of a plant of 60-million Imperial gallons daily capacity. It was stipulated as part of the contract between the city and the company, that the inventor of the process would reside in Toronto during the construction of the plant and until its acceptance by the city. As a result of this contract, Mr. Gore came to Canada and devoted most of his time to the new plant at Toronto Island until its formal acceptance several months ago. During the past few years Mr. Gore, in collaboration with Mr. Storrie, also designed and constructed small filtration units for the Collingwood fisheries, the Dominion Bank building at Toronto, and the Sun Life building at Montreal. He also designed and recently completed a filtration plant of 1,728,000 Imperial gallons daily capacity for the town of Oshawa, and an effluent disposal works for the Robson tanneries at Oshawa. Under Mr. Gore's direction, the ver Mehr Co. is now constructing a small filtration plant at Rockland, Ont. Mr. Gore is a member of the Institution of Civil Engineers of Great Britain, of which he is a George Stevenson gold medallist of the year 1907. He is also a member of the Engineering Institute of Canada and of the American Water Works Association.

G. CORDON COTTRELL, general manager of the Dominion Salvage and Wrecking Co., Toronto, has resigned.

HON. ANTONIO GALIPEAULT has been "sworn in" as Minister of Public Works in the Quebec provincial cabinet.

A. S. CLARSON, who a couple of weeks ago resigned the secertaryship of the Association of Canadian Building and Construction Industries, intends to re-engage in private practice in Montreal. Mr. Clarson was formerly city engineer of Verdun, P.Q.

THEO. J. LAFRENIERE, sanitary engineer of the Quebec Provincial Board of Health, is one of the three men named by the lieutenant-governor of Quebec as members of the provincial housing commission. Mr. Lafreniere is also a professor of sanitary engineering at Ecole Polytechnique, Montreal.

D. H. SCOTT, formerly assistant chief draftsman of the Manitoba Public Works Department, has been appointed chief draftsman, succeeding the late G. H. Baird. Mr. Scott enlisted early in the war and upon his return was attached to the Hospital Commission. He returned to the provincial works department in July.

E. A. JAMES, MAJ. T. R. LOUDON and LT.-COL. C. S. L. HERTZBERG, who have been the partners in the consulting firm of James, Loudon & Hertzberg, Ltd., Toronto, have decided to dissolve partnership. Mr. James will continue the present business, probably under the firm name of E. A. James, Ltd., while Maj. Loudon, Col. Hertzberg and a well-known Montreal engineer will establish a new firm as consulting and supervising structural engineers, with offices in Toronto and Montreal.

NEW CONSULTING FIRM, GORE, NASMITH & STORRIE, TO SPECIALIZE IN PUBLIC HEALTH

ANNOUNCEMENT has been made of the organization of a new firm of consulting engineers, Gore, Nasmith & Storrie, of Toronto, who will specialize in all forms of public health engineering, including water works, sewerage, sewage disposal and bacteriological research.

The partners in the firm will be William Gore, consulting engineer of the John ver Mehr Engineering Co., Ltd, Toronto; Col. Geo. G. Nasmith, director of laboratories of the Department of Health, city of Toronto; and William Storrie, chief engineer and general manager of the John ver Mehr Engineering Co., Ltd.

Both Mr. Gore and Mr. Storrie have tendered their resignations to the ver Mehr Co., but Mr. Gore's resignation will not take effect until other arrangements have been completed by Mr. ver Mehr for the management of the latter's Toronto office. Mr. Storrie's resignation took effect at the beginning of this month. It is not expected that Col. Nasmith will sever his relations with the city of Toronto until the end of this year, and meanwhile the work of the new firm will be carried on mainly by Mr. Storrie.

A detailed record of Mr. Gore's career appears in the "Personals" column of this page.

Col. Nasmith is a graduate of the University of Toronto and has received the degrees of M.A., Ph.D., D.Sc., and D.P.H. (Doctor of Public Health), and as a result of his sanitation work at the front for the British army, he was honored two years ago with the Companionship of St. Michael and St. George. He has been director of laboratories at Toronto for the past eight years.

Mr. Storrie is a graduate of the Glasgow and West of Scotland technical college. He came to Canada in 1909 as resident engineer on the construction of the slow sand filtration plant at Toronto Island. In 1912 he was appointed in control of the water works system at Ottawa during that city's second typhoid epidemic. In 1913 he returned to Toronto to accept the position from which he has just resigned. Early in 1918, Mr. Storrie went to England to take charge of the construction of several concrete ships for which the ver Mehr Co. had Admiralty contracts, returning again to Canada about two months ago.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand or proposed, contracts awarded, changes in staffs, etc.

TENDERS PENDING

Further information may be had from the issues of *The Canadian Engineer*, to which reference is made.

PLACE OF WORK	TENDERS CLOSE	ISSUE OF	PAGE
Caughnawaga, Que., road work	Sept. 19.	Sept. 11.	41
Hanley, Sask., supply, delivery and erection of machinery and materials	Sept. 24.	Sept. 11.	44
Little River, N.S., repairs to breakwater	Sept. 25.	Sept. 11.	48
Minitona, Man., Bobcaygeon Section, Trent Canal	Sept. 29.	Sept. 11.	44
Naramata, B.C., construction of wharf	Sept. 22.	Sept. 11.	48
Provost, Alta., erection of schoolhouse	Sept. 20.	Sept. 11.	46
St. Thomas, Ont., alterations to post-office	Sept. 18.	Sept. 11.	48

BRIDGES, ROADS AND STREETS

Alvinston, Ont.—Tenders will be received until 2 p.m., September 27th, by Brooke township council for construction of repairs to 3-4 sideroad. Plans at office of clerk, lot No. 16, concession No. 9, Brooke. Commissioners, L. Lindsay, R.R. No. 2, Alvinston and C. Atkin, R.R. No. 1, Inwood.

Bowmanville, Ont.—Petitions for cement walks on George St., from Church to Pinch's Lane; Duke St., from Durham to Base Line; Ontario St., from Albert to Nelson, were granted by the town council.

Bowmanville, Ont.—Town council passed by-laws authorizing the construction of cement walks on Concession, Liberty, Queen and Scugog Sts. Town engineer, Chas. F. Gibson.

Dundas, Ont.—Contract awarded to James A. Vance and Co., of Woodstock, for the erection of a new bridge at Head St.

Islington, Ont.—Etobicoke council are calling for tenders for construction of a four-foot concrete sidewalk on Scarlett Rd., from Bridge St., northerly, 859 lin. ft.

Kingston, Ont.—Contract let to W. H. Harvey by the Department of Public Works, Ottawa, for grading and road work.

Kamloops, B.C.—City Engineer Eric T. Kingswell will report to the city council on necessary repairs to streets. Tenders will be called for the widening of Columbia St.

North Temiskaming, Que.—The Hamilton Bridge Co. have secured contract and commenced construction of steel highway bridge across the River des Quinze. Length, 600 ft., two spans of 240 ft. each and two spans of 60 ft.

Orillia, Ont.—The Grand Trunk Ry. bridge at the Narrows, near Orillia, is to be replaced by a new structure, 344 ft. long, and work has already commenced.

Orillia, Ont.—A by-law authorizing the construction of pavement on West St., from Coldwater St. to Neywash St., has been passed by the town council. Town engineer, J. S. Blickersderfer.

Oxford Centre, Ont.—Tenders will be received until September 20th, for construction of steel and concrete bridge, 22 ft. span, opposite lot No. 8, concession No. 3, East Oxford Township. Engineer, F. J. Ure, Woodstock. F. G. Jackson, clerk, East Oxford.

Revelstoke, B.C.—Construction, under contracts recently awarded by the department of public works, Victoria, B.C., to Angus McDonnell, Vancouver, B.C., has been started on the section from Revelstoke to four miles westerly, and from Arrowhead two miles toward Revelstoke. Wm. Ramsay, resident engineer.

Richmond, B.C.—Contracts have been awarded by the department of public works, Victoria, for construction of surface, 16 ft. wide, on No. 3 road, Lulu Island, as follows: To Harrison and Lamond, 12,000 sq. yds. and to M. P. Cotton Co., 12,100 sq. yds. Approximate cost, $40,000.

Riverside, Man.—The municipal council has authorized the sale of debentures amounting to $84,500 to provide for the draining, grading and gravelling of 81½ miles of roads. Town clerk, E. M. Putnam, Dunrea, Man.

Scarboro Township, Ont.—Township council proposes to open Danforth Ave., from Birchmount Ave. to Kingston Rd.

Sherbrooke, P.Q.—See item under "Sherbrooke" in "Factories and Large Buildings" section of this issue, mentioning bridges for which contracts have been recently received by the MacKinnon Steel Co., Ltd.

St. Cecile, P.Q.—Contract awarded to Louis Cosette by town council for the construction of macadam roads estimated to cost $21,825.

St. Clement, P.Q.—Municipal council has awarded contract to Achille Picard, Beauharnois, P.Q., for the construction of bituminous macadam roads estimated to cost $30,266.

St. John, N.B.—A comprehensive street paving proposition to cover a period of four years and involving the expenditure, if adopted, of from $800,000 to $1,000,000, is to be prepared by City Engineer G. N. Hatfield.

Toronto, Ont.—A deputation of ratepayers from Mount Pleasant district will request the city council to widen Mount Pleasant Rd. to 86 ft.

Toronto, Ont.—City council intends to construct asphalt pavements on St. Clair Ave. estimated to cost $129,032. City clerk, W. A. Littlejohn.

Toronto, Ont.—At a recent meeting of the Board of Control Mayor Church moved that the Assessment Commissioner, the Commissioner of Works and the Finance Commissioner report on the advisability of extending University Ave. from Queen to Front Sts.

Toronto, Ont.—Mayor Church will move for the revival of the by-law (passed in 1914 and repealed in 1917) calling for the extension of Teraulay St. by joning it up with St. Vincent, Chapel Lane, North and Ketchum Sts. to Davenport Rd. The by-law provided for the widening of these streets from College St. to Davenport Rd. to 86 ft.

Toronto, Ont.—A typographical error was made in this column in our issue of September 4th in the address of Lieut. J. G. Murphy, to whom was awarded the contract for one section of the Ontario provincial highway. Mr. Murphy's address is 84 Dominion St., Toronto, and not 28 Dominion St., as reported. Before enlisting in the army Mr. Murphy was with the Edmonton Contracting Co.

Toronto, Ont.—The recommendation of Commissioner of Works R. C. Harris for the construction of brick block and asphalt pavements from Gerrard St. to 410 ft. north of Walpole Ave. on Morley Ave. at an estimated cost of $29,148 has been approved by the works committee.

Tres Saint Sacrement, P.Q.—Parish council has awarded contract to Leger and Charleton for the construction of a macadam road to cost $9,900.

Waterloo, Ont.—Town council is considering the construction of a driveway along the park. Town clerk, James C. Haight.

Winnipeg Man.—The Good Roads Board will call for tenders for bridgework in the municipalities of Woodworth. Ritchot, De Salaberry, Elton, Daly, Mineota, Stanley and Franklin.

Winnipeg, Man.—Contracts have been awarded by the Good Roads Board as follows: Gravelling 12 mls. highway at St. Francois Xavier, to H. E. Walker, $25,000; construction of concrete bridge, municipality of Wallace, to W. F. Manser, $2,740; reinforced concrete culverts, municipality of North Norfolk, to W. Folkhammer, MacGregor, $5,250; concrete bridge, Rockwood, to Schaler Lacour, Winnipeg, $3,275; concrete culverts, Rockwood, to W. Sampson, Winnipeg, $2,425; concrete bridge, Morden, to W. J. Harris, Morden, $2,916; 4 mls. grading, municipality Richot, to A. Berriault, St. Adolphe, $4,600.

York Township, Ont.—Contract has been awarded by township council for construction of Tarvia X pavement on Westmount Ave., from north end of present part to Miller Ave., to Asphaltic Concrete Co., $3,965. Frank Barber, engineer, 40 Jarvis St., Toronto.

York Township, Ont.—Contracts have been awarded by the township council for construction of sidewalks as follows: To Angotti and Smythe, Bernice Cres., N.S., $4,725, Dennis St., N.S., $1,627.25; to National Construction Co., McRoberts St., both sides, $8,288; to Walton and Rowell, Poulton Ave., N.S., $2,900, Torrens Ave., both sides, $5,510. Rejected tenders: Angotti and Smythe, McRoberts, $10,292, Poulton Ave., $5,049.25; Sheridan Co., Bernice Cres., $6,305, Dennis, $2,435, McRoberts, $11,789.50, Torrens, $18,832.20; Johnson Co., Bernice Cres., $4,850, Dennis, $1,750, Poulton, $4,369, Torrens, $7,000; National Construction Co., Bernice, $5,425, Dennis, $2,128, Poulton, $5,846, Torrens, $7,800. Frank Barber, engineer, 40 Jarvis St., Toronto.

York Tp., Ont.—Miles of new concrete sidewalks will be laid before the coming winter. Contracts have been let for a great amount of work and tenders will be called for the rest within a few days. The programme provided for calls for over five miles of walks as follows: Torrens Ave., north side, from Don Mills Rd. to Leslie St., and on the south side, from Don Mills Rd. to Pape Ave.; Keene St., west side, from Sammon Ave. to Mortimer St.; Weston Rd., both sides, Lambton Ave. to Eglinton Ave.; Barr Ave., both sides, Weston Rd. to Brownhill Ave.; Lauder Ave., west side, Miller Ave, northerly, 401 ft.; St. John's Rd., north side, city limits to Jane; Glenholm Ave., east side, Medway to Rogers Ave.; Atlas Ave., west side, city limits to Hurstings Ave., and east side city limits to Normanna Ave.; St. Clair, north side, from city limits to Jane St.; Brownhill Ave., both sides, from Eglinton Ave. southerly 900 ft.; Bernice Cres., north side, from Eileen Ave.; Poulton Ave., north side, from Woodbine westerly 1,942 ft.; Dennis Ave., north side, Weston Rd. to Syndicate Ave.; McRoberts Ave., both sides, from city limits northerly 1,735 ft.; Pape Ave., east side, from city limits northerly 4,000 ft. Clerk, W. A. Clarke, 40 Jarvis St., Toronto.

York Tp., Ont.—Township council intends to construct a Tarvia X pavement on Millerson Ave., from Glenholme Ave. westerly to Lauder Ave., 240 ft., estimated to cost $3,000. Clerk, W. A. Clarke.

WATER, SEWAGE AND REFUSE

Alvinston, Ont.—Tenders will be received until 2 p.m., September 27th, by Brooke township council for construction of drain, concession 8-9. Commissioners, L. Lindsay, R.R. No. 2, Alvinston and C. Atkin, R. R. No. 1, Inwood, Ont.

Bowmanville, Ont.—Town council authorized Engineer Chas. F. Gibson to construct a sewer and water main on George St.

Calgary, Alta.—The Alberta government, with the aid of the Federal government, will put into effect a comprehensive irrigation scheme along lines already determined by Federal government surveys. Acreage possible to be irrigated in Alberta, 5,000,000.

Chatham, Ont.—A sewer will be constructed in Kirk St. City engineer, Mr. Adams.

Chatham, Ont.—Ratepayers will be asked to vote on by-laws providing for extension of waterworks plant, scheme for merging the water commission, extension of parks, athletic park and change of civic government to city managership.

Cobourg, Ont.—A by-law to grant the Douglas Packing Co. $5,000 towards securing an adequate supply of water for their new plant was carried by the property owners of Cobourg recently.

Halifax, N.S.—The city council will shortly call for tenders for a sewer and water pipe trench on Harvard St., and sewer and water extension on Russell St., from Agricola to Robie. A sewer is also to be laid on North Park St., from Cornwallis to Cogswell. City engineer, F. W. W. Doane.

Maidstone, Ont.—Tenders will be received until noon, September 20th, by township council, Sandwich South, for repairs to the following drains: Donovan, Sullivan creek, Sixth Concession, Twelfth Concession and South Talbot. Plans, etc., J. S. Laird, Essex, and John McAuliffe, clerk, Maidstone.

Orillia, Ont.—Town council passed a by-law to borrow $24,000 for waterworks extensions and improvements. Town engineer, J. S. Blickersderfer.

Pelee Township, Ont.—Extensive work will soon be undertaken to improve the Big Marsh drainage system. Tenders have been called and contracts will soon be awarded for dredge cutting and embankment, reinforced concrete and other work at East Side Pumping Station, furnishing and installing a new submerged centrifugal pump in the West Side Pumping Station. Engineer in charge, Alex. Baird, Leamington.

Preston, Ont.—Board of works is considering the construction of sewers from Hamilton St. North to Main St. Town engineer, C. S. Mackenzie.

Regina, Sask.—The provincial government contemplates construction of a joint water works system for the towns and cities, from Moose Jaw to Regina. Water would be obtained by diverting the flow from the South Saskatchewan river, near Elbow.

Sarnia, Ont.—City council adopted the report of the waterworks committee, recommending the purchase of a chlorinating plant for the Point Edward waterworks and a six-inch water main for Cromwell St. City engineer, J. A. Baird.

Smith's Falls, Ont.—Town council passed a by-law authorizing the issuing of debentures to raise $5,574 to extend the waterworks along Queen St., from Thurber to Carthage Sts. Town engineer, J. H. Moore.

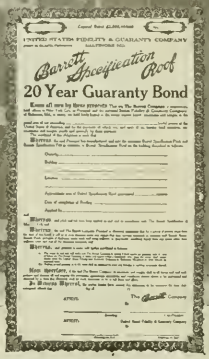
Toronto, Ont.—Trenches are being excavated on the University campus for construction of water pipes to irrigate the large lawns.

York Township, Ont.—By-laws have been passed providing for construction of water works system in Sections A. and B., construction of sewers, streets and sidewalks. Total estimated cost, $211,315.16.

York Township, Ont.—Ratepayers of Birch Cliff district have decided that work on the construction of a local water system should commence at once. A pumping station will be located on lake shore and the area to be served contains three square miles. Estimated cost, $100,000. Reeve, J. G. Cornell. Engineer, E. A. James, Toronto.

York Township, Ont.—Contracts have been awarded by township council for construction of water mains as follows: To Peter Iles, Mitchell Ave., $1,220.28, Morningside Ave., etc., $2,038.88, Amherst Ave., etc., $6,438.48, Northcliffe Blvd., $586.95, Lauder Ave., $3,365; to Murphy Contracting Co., Craydon Ave., $3,937.72; to A. Cavotti, Northland Ave.,

Barrett 20-Year Specification Roof on the Mercury Mills, Hamilton, Ont. Engineer and Architect—C. T. Main, Boston, Mass. Roofers—Dennis and Jocelyn, Hamilton, Ont.



This is the bond that guarantees your roof for 20 years.

Cover Your Investment with a 20-Year Guaranty Bond—

Every one knows that a structure of concrete and steel will endure for a generation and more.

But how about the roof that covers the structure?

Frequently that is not only an unknown quantity but a *liability* rather than an *asset*.

It is a short-sighted and costly policy to put a *poor* roof on a *good* building.

As one of the oldest and largest manufacturers of materials used in constructing roofs, we have done our part to make *all* roofs *good* roofs.

Years ago, for that reason, we induced the leading architects and engineers to unite in the adoption of The Barrett Specification as a satisfactory *standard specification*.

Now we go a step further by sending our Inspectors to check up on the construction, and if they find that The Barrett Specification has been properly complied with, we will, without charge, issue a 20-Year Guaranty Bond *exempting the owner from all further expense for repairs or up-keep on that roof for twenty years.*

This service may be had on all roofs of fifty squares or larger in all towns of 25,000 population or more and in smaller places *where our Inspection Service is available.*

Our guaranty is a real Surety Bond issued by one of the largest Surety Companies in the world. Our only requirements are that The Barrett Specification dated May 1, 1916, shall be strictly followed and that the roofing contractor shall be approved by us and his work subject to our inspection.

Thus, in spite of the fact that we do not build roofs ourselves, we are put in a position where we can guarantee the delivery of the long years of service which these roofs are capable of giving.

A copy of The Barrett 20-Year Specification, with roofing diagrams, sent free on request.

The Barrett Company LIMITED

MONTREAL TORONTO WINNIPEG VANCOUVER
ST. JOHN, N.B. HALIFAX, N.S. SYDNEY, N.S.

etc., $3,086.41, Cliff St., etc., $4,903.50. Rejected tenders, Murphy Contracting Co., Mitchell Ave., $1,656.75, Morningside Ave., $2,586.60, Amherst Ave., $6,769.10, Northcliffe Blvd., $777.80, Lauder Ave., $4,473.50, Northland Ave., $3,328.56, Cliff St., $5,117.50. A. Cavotti, Mitchell Ave., $1,389.88, Northcliffe Blvd., $709.94, Lauder Ave., $4,270.50. Frank Barber, engineer, 40 Jarvis St., Toronto.

York Tp., Ont.—Township council intends to construct 6-inch cast-iron water mains, together with all specials, valves, hydrants, etc., on (1) Belvidere Ave., from Oakwood Ave. easterly to Alameda Ave., 680 ft., estimated to cost $3,900; (2) (a) Forest Hill Rd., from Spadina Rd. southeasterly to Huron St., 936 ft.; (b) Huron St., from Coulson Ave. northerly to Forest Hill Rd., 2,730 ft.; (c) Burton Rd., from Kendal Ave. westerly to the west end, 690 ft.; (d) Claremount Rd., from Bathurst St. easterly to east end, 430 ft.; (e) Westmount Drive, from Bathurst St. easterly and southerly to south end, 1,321 ft., estimated cost, $24,000; (3) (a) Sunnybrae Cres., from Weston Rd. south-west, northwest and north to Bartonville Ave., 1,168 ft.; (b) Denarda St., from Weston Rd. easterly to Marston St., 367 ft., cost, $6,000; (4) (a) Corbett Ave. (formerly Florence Ave.), from Jane St. easterly to east end, 1,774 ft.; (b) Mould Ave. (formerly Hannah Ave.), from Pritchard Ave. northerly to Corbett Ave., 235 ft., cost $8,000. W. A. Clarke, clerk.

LIGHT, HEAT AND POWER

Halifax, N.S.—The Nova Scotia Power Commission has decided to obtain estimates on the cost of developing Indian River, fifteen miles from Halifax and bringing power into the city.

Swan River, Man.—Tenders will be called shortly for an electric power and lighting plant.

Toronto, Ont.—The Toronto Hydro-Electric system will proceed with installation of an electric lighting system in the Woodbine Heights district, York township.

Toronto, Ont.—The Hydro-Electric Commission is experimenting with a new type of lamp, which, if successful, will be placed in general service to illuminate the streets of Toronto. Commissioner Chisholm.

RAILWAYS

Bluesky, Alta.—Ratepayers are preparing petition requesting construction of a branch line railway to townsite of Vanrena, Alta.

Edmonton, Alta.—The Dominion government will consider purchase of the McArthur railways in the Peace river district, to be operated as part of the Canadian National Railways. Premier Stewart, Alberta.

Galt, Ont.—Hydro-Electric Power Commission will have estimates of cost of hydro-radial construction completed in time for by-laws to be submitted by January 1st, 1920. A. W. Mercer, mayor.

Hamilton, Ont.—Controller Halcrow, who has been actively interested in Hydro-Radials since Hamilton carried the by-law at the last election, announced last week that the Toronto-Hamilton Hydro line would be started in the near future, and that the work would be rushed to completion.

Hamilton, Ont.—City council has passed a resolution requesting the Hydro-Electric Power Commission to survey, lay out, construct, build, equip and operate a railway and to acquire lands and yards, sidings and other facilities for railway traffic east of the city; to provide yards for the accommodation of the T.H. and B. Ry. Co., in lieu of the present Kinnear yards. Estimated cost, $300,000.

Hawarden, Sask.—Joint request from the ratepayers of Hawarden and Saskatoon board of trade will be made to the C.P. Ry. for construction of the Hawarden-Saskatoon extention. J. R. Wilson, Saskatoon.

Ottawa, Ont.—It is expected that the G.T.R. Co. will agree to arbitrate question of rentals for their lines in Canada to the C.N. Ry. Estimated annual rental, $3,600,000 to $5,000,000.

Prince Albert, Sask.—The spur tracks from the C.N. Ry. and G.T.P. Ry. into the stock yards will soon be completed. The runways and loading platforms will be constructed immediately. J. M. Paul, managing director, stock yards.

Toronto, Ont.—Plans for construction of the proposed Mount Pleasant car line have been prepared and submitted to the Railway Board for approval.

Windsor, Ont.—Plans are being prepared for construction of hydro-radials from Windsor, connecting the border cities with points eastward as far as Toronto. Sir Adam Beck, chairman, Hydro-Electric Power Commission.

FACTORIES AND LARGE BUILDINGS

Amherst, N.S.—Town council proposes to erect a skating rink.

Amherst, N.S.—Barry D. Best proposes to erect a 3-story brick building on Electric St.

Amherstburg, Ont.—Tenders are being called by the Imperial Bank of Canada for the erection of a new building. Head office, Toronto.

Biggar, Sask.—Plans are being prepared for a modern hospital and 10-roomed nurses' home. J. Melrose Morrison, Regina, architect.

Brantford, Ont.—The G.W.V.A. has purchased the old post office building from the city council and will make extensive alterations. Estimated cost of remodelling, $75,000.

Brantford, Ont.—The Dominion Steel Products Co. has announced that, on account of objections by Mayor Macbride against the closing of Leonard St. for a large extension of the company's plant, the firm had decided not to go on with the contemplated work.

Brockville, Ont.—The town council has passed a by-law making applicable to Brockville the recently enacted Ontario Housing Act.

Chatham, Ont.—Building permit has been issued to the Bell Telephone Co for construction of a new exchange building. Estimated cost, $46,000. Contractors, Secord Bros., Brantford.

Chatham, Ont.—A brick building, 400 ft. long, owned by the Dowsley Spring and Axle Works, was completely gutted by fire last week. Loss, about $50,000. W. G. Sprague, manager.

Chatham, Ont.—The local lodge of the Knights of Columbus have decided to erect a new parish hall.

Cliffdale, Alta.—Tenders will be received until noon, September 21st, for erection of a frame school building. A. L. Hilsabeck, secretary-treasurer, Cliffdale school district No. 3687.

Corbyville, Ont.—Work has commenced on the erection of a new grain elevator. Concrete construction.

Dundas, Ont.—Alexander Motherwell of Canada, Ltd., are making extensive improvements and enlargements to their plant. Two large grain storage bins are being constructed to the rear of the plant and considerable new machinery is being installed. Enlarged capacity of plant, 10 cars per day.

Goderich, Ont.—An 1,100-acre site has been purchased by the Lake Huron Steel Corporation for their new plant here.

Guelph, Ont.—Tenders will be received until September 22nd, by the department of public works, Ontario, for construction of an apiary building at the O. A. College, Guelph. Plans, etc., Bursar's office, O.A.C., and Parliament buildings, Toronto. H. F. McNaughten, secretary.

Halifax, N.S.—The building on Granville St., occupied by the Dominion Express Co., is to have a three-story addition on the south, and the excavation for the foundation is now being made. The addition will be of brick.

Burlington Steel Co., Ltd.

Hamilton, Canada

STEEL BARS

For

Concrete Reinforcing

THE MOST IMPORTANT FACTOR IN CONCRETE REINFORCEMENT IS THE TENSILE STRENGTH AND ELASTIC LIMIT OF THE REINFORCING BAR.

OTHER THINGS BEING EQUAL, STEEL HAVING THE HIGHEST ELASTIC LIMIT, OR YIELD POINT, WILL BE THE MOST SATISFACTORY FOR REINFORCEMENT. WHEN UNDER STRAIN, AS SOON AS THE ELASTIC LIMIT OF ANY REINFORCING BAR IS REACHED, THE METAL STRETCHES RAPIDLY DECREASING IN SECTION, DRAWING LOOSE FROM THE CONCRETE AND DESTROYING THE MONOLITHIC BOND EXISTING BEFORE THIS POINT IS REACHED THEREFORE, THE SAFETY OF THE ENTIRE CONSTRUCTION IS IN DIRECT PROPORTION TO THE ELASTIC LIMIT OF THE STEEL USED.

THE ELASTIC LIMIT OF RAIL CARBON STEEL IS 50,000 TO 60,000 POUNDS PER SQUARE INCH, EITHER TWISTED OR PLAIN, AS COMPARED WITH AN ELASTIC LIMIT OF 25,000 TO 30,000 POUNDS IN SOFT STEEL.

THAT'S WHY RAIL CARBON STEEL, WITH ITS 80,000 POUNDS MINIMUM TENSILE STRENGTH, IS RECOMMENDED AS BEING FAR SUPERIOR FOR ALL KINDS OF REINFORCED CONCRETE WORK.

AT OUR HAMILTON, ONT., WORKS WE BUY SELECT RAILS, AND ROLL THEM INTO RAIL CARBON STEEL REINFORCING BARS IN A PLANT WHICH IS THE EMBODIMENT OF THE LATEST THOUGHT AND PRACTICE.

THESE BARS CAN BE SUPPLIED FROM STOCK IN VARIOUS SIZES, LENGTHS AND SHAPES. WE CAN ALSO ROLL SPECIAL SHAPES AND SIZES TO FIT YOUR PARTICULAR REQUIREMENTS.

Bars bent to shape for Beams, Stirrups, Etc.

PROMPT SHIPMENT

Hamilton, Ont.—Wood, Alexander and James will construct a new warehouse at Ferguson Ave. and King William St. Estimated cost, $280,000.

Hamilton, Ont.—The building committee of the Board of Education recommended to the city council that the bulk tender of W. H. Cooper for the erection of a 12-roomed school on Hunter St. West for the sum of $98,775 be accepted.

Hamilton, Ont.—Permits for construction work totalling $450,000 have been taken out by the Frid Construction Co. Three important works are included. One is the new building on Hughson St. North for the T. Eaton Co., Ltd., a $100,000 structure; another, the $280,000 building for Wood, Alexander and James, at the corner of King William St. and Ferguson Ave., and the third, the new $15,000 building for the Smart-Turner Machine Co.

Kerrobert, Sask.—A new union church building will be erected here. Pastor, Rev. Harold Marshall. Estimated cost, $15,000.

Kimberley, B.C.—Tenders will be received by the department of public works, Victoria, until 12 o'clock noon, September 22nd, for construction of school. Plans, etc., office of government agent, Vancouver and Cranbrook, B.C. and W. W. Burdette, Kimberley, B.C. A. E. Foreman, engineer.

Kingston, Ont.—A plan is on foot for the reconstruction of the Barriefield hutments into permanent barracks. Kingston also has a scheme for a union railway station.

Kingston, Ont.—G. Y. Chown has subscribed $10,000 toward the erection of a public library building conditional on a further amount of $40,000 being secured for that purpose.

Leamington, Ont.—The town council will purchase a site for the erection of a school. Clerk, R. M. Selkirk.

London, Ont.—The erection of a new city hall is contemplated.

London, Ont.—The ratepayers will vote on the advisability of erecting a memorial hall immediately west of the armories. City clerk, S. Baker.

Manyberries, Alta.—Tenders will be received until noon, September 27th, by Delayed school district No. 3764, for construction of frame school building. A. Brand, secretary-treasurer.

Mimico, Ont.—As a result of a series of conferences between the Goodyear Tire and Rubber Co. and the Mimico Housing Commission, 20 new brick houses will be built under the provincial scheme on Murrie St., and tenders will be called for immediately. The launching of a more comprehensive programme along similar lines is being contemplated for 1920.

Moncton, N.B.—A movement is on foot here for the erection of a home for girls.

Moose Jaw, Sask.—The contract for a three-story and basement office building, 40 by 80 feet, for the Robin Hood Mills, to be erected on High Street and Fifth Ave. West, and costing $50,000, has been let to A. E. Hamilton, Moose Jaw. The building will be of reinforced concrete construction.

New Westminster, B.C.—School board will request school boards and councils of all municipalities to unite with them in requesting Dominion government to establish technical schools under their plan, which provides for expenditure of $10,000,000 in the next ten years, to be allotted to the various provinces on basis of population, each province to contribute dollar for dollar with the Dominion. S. Bowell, chairman. J. D. MacLean, minister of eduction.

North Sydney, N.S.—Hospital board will construct extensions to, and remodel part of the present Hamilton Memorial Hospital buildings. W. S. Thompson, secretary.

Orillia, Ont.—Tenders will be received up to noon, September 26th, 1919, by Eustace G. Bird, architect, 6 King St. West, Toronto, for the several works required in the erection and completion of a semi-fireproof hospital building. Plans and specifications may be obtained at the office of the architect, and also from the chairman of the Hospital Board, Geo. Thomson, Orillia.

Ottawa, Ont.—The first contract for the building of dwelling houses on the Lindenlea property of the Ottawa housing commission has been let. This contract calls for the erection of ten houses. Other contracts may be announced shortly. Altogether there are 168 houses to be built.

Saskatoon, Sask.—Tenders will be received by the University of Saskatchewan, Saskatoon, up to September 20th, 1919, for all the work and materials for the electrical work on the Physics Building and extension to the Engineering Building. Plans and specifications may be seen at the University and at the office of Brown and Vallance, architects, Montreal.

Selkirk, Man.—The town council is planning to build a new collegiate, to cost approximately $30,000. The plans call for a brick building.

Sherbrooke, P.Q.—Among the contracts recently received by the MacKinnon Steel Co., Ltd., are the following: Structural steelwork for Belding Paul Corticelli Building, St. John's, P.Q., general contractor, Anglins, Norcross, Ltd., Montreal; steelwork for St. Augustine's Church, Cote St. Antoine Rd., Montreal, general contractor, M. J. Stack; steelwork for extension to Dominion Tire Factory, Kitchener, Ont., general contractor, Atlas Construction Co., Montreal; superstructure for 200-ft. span bridge to be erected on the East Branch of the River Yamaska; superstructure for 215-ft. span bridge to be erected over the Riviere Noire, municipality of St. Valerien, Shefford Co., P.Q. This company are also fabricating steelwork in connection with an extension to their own office, for which the general contractor is the Sherbrooke Construction Co.

St. John, N.B.—City Engineer G. N. Hatfield submitted a report to the city council on repairs necessary to the exhibition buildings estimated to cost $20,000.

St. John, N.B.—The Corona Candy Co. is planning to enlarge its plant.

St. Mary's, Ont.—At the January elections the ratepayers will vote on a by-law to provide for the erection of a Great War Veterans' club house. Clerk, Thos. M. Clark.

Swan River, Man.—The municipality is advertising for tenders for the erection of a hotel.

Sydney, N.S.—Contracts have been awarded by the C.N. Ry. for construction of a modern coaling plant to Bate and McMahon. Construction of general stores building to Chappel Bros.

Sydney, N.S.—The Nova Scotia Steel and Coal Co. will erect a by-product plant in the near future to cost over $2,000,000. The plant will be erected in connection with the company's works at Sydney Mines. The erection of the new ovens will mean a further enlargement of the present plant and the necessity for the erection of an additional blast furnace, which will cost another $1,500,000.

Three Rivers, Que.—A large plant will be erected here immediately. Lava Cement, Clay and Silicate Products Co.

Timmins, Ont.—Arrangements for laying out a townsite are being made at the Davidson Consolidated Gold Mines, and a church and school will be built in the near future. It is also the intention to build about 40 cottages, and an addition to the mill.

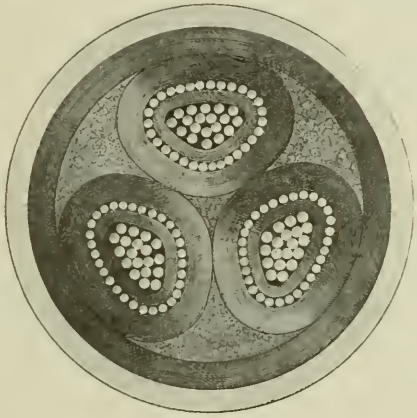
Toronto, Ont.—The police commissioners contemplate enlarging the present station building on Keele St., West Toronto.

Toronto, Ont.—Board of Control approved the expenditure required for new public libraries in Earlscourt and East Toronto.

Toronto, Ont.—City council decided to spend $110,000 on the erection of a stadium at the old Rosedale lacrosse grounds.

Toronto, Ont.—J. J. McLaughlin, Ltd., will construct alterations and additions to factory, 145 Sherbourne St. Estimated cost, $16,000.

SPLIT-CONDUCTOR CABLES



250,000 C.M. 3-CONDUCTOR 13,200 VOLT
PAPER-INSULATED, LEAD COVERED CABLE

Eugene F. Phillips Electrical Works, Ltd.

MONTREAL

Branches: Toronto, Winnipeg, Regina, Calgary, Vancouver

Toronto, Ont.—The Home Bank of Canada will construct a branch bank building on Danforth Ave., corner of Main St. Estimated cost, $20,000.

Toronto, Ont.—The Anchor Cap Co., Brooklyn, have commenced construction of a concrete and brick factory on Wallace Ave. Estimated cost, $45,000.

Toronto, Ont.—A by-law authorizing the issue of debentures to the value of $509,000 for the enlargement of public schools was passed by the city council last week.

Toronto, Ont.—Permit has been received by J. and J. Allen for construction of new Allen theatre at corner of College St. and Dovercourt Rd. Estimated cost, $100,000.

Toronto, Ont.—New tenders will be invited for some of the trades involved in the erection of certain schools, including the Norway School addition.

Toronto, Ont.—Quaker Candy Co. have obtained a permit for an addition to their factory at 420 Queen St. at a cost of $18,000.

Toronto, Ont.—Norcross Bros., the original builders of the Technical School, under the supervision of the architects, Ross and Macdonald, will make repairs to the stonework in the two turret towers, which have become necessary. Estimated cost, $12,000.

Toronto, Ont.—A banking and office building will shortly be erected by the Imperial Bank of Canada on the south-west corner of Kingston Rd. and Balsam Ave.

Toronto, Ont.—The Canadian Bank of Commerce will erect a new branch bank building on the south-west corner of Coxwell and Danforth Aves.

Toronto, Ont.—The Imperial Oil Co. have awarded contract for gasoline service station, corner Bloor and Howland Ave., to John V. Gray Construction Co., Ltd., 625 Confederation Life Building, Toronto.

Vancouver, B.C.—A permit for the construction of a garage at 1140 Georgia St. West has been taken out by R. J. Snelgrove. Estimated cost, $10,000.

Vancouver, B.C.—A by-law will be submitted to the ratepayers this month, providing for the expenditure of $200,000 on a technical college in this city. City clerk, W. McQueen.

Vancouver, B.C.—It is understood that a plant to manufacture and assemble marine machinery will be located on Burrard Inlet on water frontage adjoining P. Burns' packing plant. Estimated cost, $1,000,000.

Vancouver, B.C.—The Gregory Tire and Rubber Co., Ltd., of Akron, Ohio, are having plans prepared for the first unit of the large factory which they propose to erect. The building will probably be two stories of reinforced concrete construction, 200 ft. by 80 ft.

Vancouver, B.C.—The Allen Theatre Co., of Toronto, will erect a theatre in this city.

Walkerville, Ont.—The town council has voted to borrow from the Ontario Government $1,000,000 to relieve the housing shortage in the community.

Waterloo, Ont.—A movement is on foot by the county council for the construction of a new building for the Old People's Home.

Waterloo, Ont.—One hundred houses will be constructed by the Dominion Tire Co., acting in agreement with the council under the Federal housing scheme.

Weston, Ont.—The Canada Cycle and Motor Co. have awarded John V. Gray Construction Co., Ltd., 625 Confederation Life Building, Toronto, the contract for an extension to their factory.

Windsor, Ont.—The Separate School Board have awarded contracts for St. Edmund's, St. Joseph and Sacred Heart Schools to John V. Gray Construction Co., Ltd., 625 Confederation Life Building, Toronto.

Windsor, Ont.—Tenders are being called by the Imperial Bank of Canada for the erection of a reinforced concrete building at the corner of Ouelette Ave. and London St. Head office, Toronto.

Winnipeg, Man.—The Red River Paper Mills, Ltd., have been granted a charter by the provincial government, and will probably construct a new mill soon.

Winnipeg, Man.—The Leslie warehouse on Assiniboine Ave. is to be converted into a salesroom and garage for the Chevrolet Motor Sales Co. at a cost of $23,000. A permit has been taken out by J. McDiarmid. The interior of the Salvation Army citadel on Rupert St. is to be remodelled at a cost of $10,000.

Winnipeg, Man.—New exhibition buildings may be erected here. City engineer, W. P. Brereton.

Winnipeg, Man.—The Board of Governors of the University of Manitoba will urge upon the government the immediate necessity of the erection of a new university.

York Tp., Ont.—On September 2nd the township council passed a by-law providing for the issue of debentures to the amount of $60,000 for an 8-roomed addition to Secord Ave. School, S.S. No. 26. Township clerk, W. A. Clarke, 40 Jarvis St., Toronto.

Yorkton, Ont.—Application for the incorporation of the Yorkton Curling and Skating Co., Ltd., has been approved by the Local Government Board. It is the intention of the company to erect at Yorkton a large modern rink at a cost of approximately $20,000. The contract for the building will be awarded shortly.

MISCELLANEOUS

Balcarres, Sask.—Extensions are planned for the rural telephone system. Wm. Penny, Balcarres.

Calgary, Alta.—The Alberta Stockyards Co., Ltd., have commenced construction of enlargements and other improvements. A new office and administrative building will be commenced immediately. Estimated total cost, $300,000. J. M. Cameron, president.

Cardinal, Ont.—A survey is being carried out by government for a new canal which is being projected to take the place of the present system of canals extending from Cardinal to Cornwall.

Edmonton, Alta.—The city commissioners have instructed City Engineer A. W. Haddow to call for tenders for the construction of the sewer for the Swift Canadian packing plant and for the excavating work for the new telephone building.

St. John, N.B.—The Federal Department of Public Works will, at an early date, call for tenders for the extension of the grain conveyer system to Berth 15, and for dredging in the harbor, preparatory for next winter's business. Secretary, R. C. Desrochers, Ottawa.

Fredericton, N.B.—Tenders will be received until noon, September 19th, by the city council, for construction of a coagulating basin at the pumping station. G. R. Perkins, city clerk.

Grand Coulee, Sask.—The Adams Rural Telephone Co. contemplate extensions to their system. Estimated cost, $3,200. N. C. Draper, secretary-treasurer.

Moose Jaw, Sask.—Contract has been awarded by city council to Gorman, Clancy, Grindley Co., for a half million-gallon centrifugal pump for the Britannia Park water extension scheme. Contract price, $1,151 f.o.b., Moose Jaw.

Notre-Dame des Sept Douleurs, Que.—Tenders will be received by the department of public works, Ottawa, until noon, October 2nd, for construction of extension to wharf. plans, etc., offices of district engineers, post office building, Montreal, and at post office, Notre Dame des Sept Douleurs, Que. R. C. Desrochers, secretary.

Perley, Sask.—Contracts will soon be awarded for construction of 23 mls. of telephone in townships 22 and 23, range 2 west of 2nd meridian.

St. Laurent, Orleans, Que.—Tenders will be received until 12 o'clock noon, October 2nd, by the department of public works, Ottawa, for construction of wharf at St. Laurent, Island of Orleans, Montmorency County, Que. Plans, etc.,

328 E.

JUST OUT!

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By Professor NELSON C. BROWN, B.A., M.F., The New York State College of Forestry at Syracuse University ; Trade Commissioner, United States Lumber Trade Commission to Europe, Department of Commerce, Washington, D.C.

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offices of district engineers, post office building, Quebec, Que., Shaughnessy building, Montreal, and post office at St. Laurent d'Orleans, Que. R. C. Desrochers, secretary.

Sydney, N.S.—Work on a $5,000,000 drydock for Louisburg harbor will begin by the first of 1920, according to a statement recently made by J. W. Maddin, one of the incorporators of the Louisburg Drydock and Shipbuilding Co. Plans and specifications for the drydock have been completed and placed before the Federal Government for approval.

Sydney, N.S.—City council will shortly float bonds to the amount of $5,000 to secure funds for necessary water extensions and street construction. Acting city engineer, P. McKinnon.

Three Rivers, Que.—Contract has been awarded by the department of public works, Ottawa, to Simpson Bros., Ltd., Montreal, for dredging of St. Maurice river at Three Rivers. Contract price, $30,480. R. C. Desrochers, secretary.

Vermilion, Alta.—The bill authorizing the town council to borrow $29,000 for the purpose of erecting a new fire hall, purchasing additional equipment for the fire department and installing five underground tanks for fire protection has been passed. Secretary-treasurer, H. P. Long.

White Point, N.S.—Tenders addressed to R. C. Desrochers, secretary, Department of Public Works, Ottawa, will be received until 12 o'clock noon, Wednesday, September 17th, 1919, for the construction of an extension to the breakwater at Scotch Cove, White Point, Victoria County, N.S. Plans and specification can be seen at the Department of Public Works,; at the offices of the District Engineers at North Sydney, N.S.; Halifax, N.S., and at the post-office, White Point, N.S.

Condensed Advs.

Advertisements under this heading at following rates per insertion, with fifty cents per insertion as minimum rate in any case; "Positions Wanted," one cent per word; all other condensed advertisements, three cents per word. Payable in advance; 50 per cent. extra if charged.

WANTED technically trained man, with view to taking up designing of electrical apparatus, principally A.C. motors. An opportunity for the right party. Box 9, *The Canadian Engineer*, Toronto.

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MANUFACTURER in Eastern Townships, having good facilities and considerable experience in the production of wide variety of machinery lines, desires to undertake the ...cture (for the Canadian or export trade) of Ameri... English machinery. Full particulars gladly upon ... 396, *Canadian Engineer*, Toronto.

... work for construction undertakings is my sp... ...ntering this line, I had eight years' experienc... ...tant in the Canadian Bank of Commerce in To... ...ther Canadian cities. Am a Canadian, married, good ... nces. During last year of war had entire charge of a... eeding and living accommodations, time-keeping, etc., for large shipbuilding corporation in United States. Interview solicited. Address Box 398, *Canadian Engineer*, Toronto.

Tenders Called For

UNITY, SASK.

Sealed Tenders registered and endorsed on the envelope, Tenders for (tender bid on) and addressed to J. M. Jensen, Secretary-Treasurer of the Town of Unity, Sask., will be received up to 6 p.m., October 15th, 1919, for the supply, delivery and erection of the following machinery and materials and for the performance of certain works:—

Tender A. For the supply, delivery and erection of one internal combustion engine.
Tender B. For the supply, delivery and erection of one generator excitor, switch-board, transformers, meters, etc.
Tender C. For the supply and delivery of one oil storage tank.
Tender D. For the supply and delivery of pole, wire and line material.
Tender E. For the erection of electric pole line.
Tender F. For the erection of Power station and cooling chamber.

Marked cheque for five per cent. (5%) of the amount of the bid must accompany each tender.

Complete sets of plans and specifications may be seen at the office of the Consulting Engineers, Saskatoon, at the Secretary-Treasurer's office, Unity, Sask. Specifications on tenders A., B., C. and D. may be seen at the office of *The Canadian Engineer*, Winnipeg and Toronto, and the Contract Record office, Montreal.

J. M. JENSEN, Esq.,
Secretary-Treasurer,
Unity, Sask.
MURPHY & UNDERWOOD,
Consulting Engineers,
Saskatoon, Sask.
352

HANLEY, SASK.

Sealed tenders, registered and endorsed on the envelope, Tenders for (tender bid on), and addressed to A. Holm, Secretary-Treasurer of the Town of Hanley, Sask., will be received up to 6 p.m., September 24th, 1919, for the supply, delivery and erection of the following machinery and materials and the performance of certain works:—

Tender A—For the supply, delivery and erection of one internal combustion engine.
Tender B—For the supply, delivery and erection of one generator, excitor, switchboard, transformers, meters, etc.
Tender C—For the supply and delivery of one oil storage tank.
Tender D—For the supply and delivery of poles, wire and line material.
Tender E—For the erection of electric pole line.
Tender F—For the erection of Power station and cooling chamber.

Marked cheque for five per cent. (5%) of the amount of the bid must accompany each tender.

Complete sets of plans and specifications may be seen at the office of the Consulting Engineers, Saskatoon; at the Secretary-Treasurer's office, Hanley Sask. Specifications on tenders A, B, C and D may be seen at the office of *The Canadian Engineer*, Toronto; *The Canadian Engineer*, Western office, 1206 McArthur Building, Winnipeg, and Contract Record office, Montreal.

MURPHY & UNDERWOOD,
Consulting Engineers,
Saskatoon, Sask.

A. HOLM, Esq.,
Secretary-Treasurer,
Hanley, Sask. 347

The Canadian Engineer

A Weekly Paper for Civil Engineers and Contractors

Protection of Owners on Cost-Plus Contracts

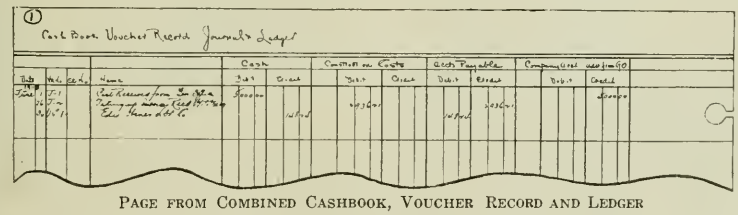
Practical Use of Dewey Decimal System in Keeping Books on the Job—Open for Inspection by Owners and Their Engineers and Architects—Distribution of Accounts—Classification of Plant Expense and Field Overhead

By F. A. WELLS

Vice-President, Wells Bros. Construction Co. of Canada, Ltd.

NO contractor who values his capital can afford to do without adequate cost records, both as a check on the job in progress and as a basis for future estimating. Yet the simpler that system of accounting, the better, and any refinements further than those necessary to give the actual required data are a waste of time and money. Some contractors keep their books under their hats or in their left-hand pocket of their coats, where all invoices go preparatory to paying. At the opposite extreme are firms who maintain a complicated system of accounts, both at the job and at the home office. Accounting methods sufficient for the lump-sum contract may be insufficient for the cost-plus-fixed-fee contract, under which the owner and his engineers and architects must have access to the accounts at all times.

The following system has been found adequate for cost-plus jobs, and with only a few changes this is the system put into effect on such typical work as that which we have done during the last few years for The Robert Simpson Co., Ltd., Toronto, and for the William Davies Co., Ltd., Toronto.



PAGE FROM COMBINED CASHBOOK, VOUCHER RECORD AND LEDGER

Occasionally we have found an owner who prefers to be given such data as will permit his own accountants to keep a complete system of books. Generally however, our accounts, kept on the job and open at all times for inspection, are considered sufficient, in view of the detail statements we render to the owner every two weeks, bearing the approval of the owner's representative, who is designated for that purpose. We urge owners to have their auditors frequently make examinations of accounts for their own satisfaction.

The system we are now using is briefly the keeping of:—(1)—Cashbook, voucher record and ledger, combined; (2)—Invoice and payroll register, combined; (3)—Detail cost record; and (4)—Accounts payable record (vendors' accounts).

The cashbook, voucher record and ledger is used for the recording of all cash received, cash disbursed by voucher and all journal entries.

The invoice and payroll register is used for the recording of all invoices and payrolls. The invoices and payrolls are numbered consecutively. This register has columns for date, invoice number, vendor's name, total amounts (both debit and credit) and individual columns for the 20 main accounts used in distribution of costs. The register represents an absolute detail control of all approved charges to the job, as only audited and approved items are given a register number or entered. The payrolls are given register numbers and approved the same as invoices. The office copies of all invoices are filed in numerical order in an ordinary letter file drawer, and bound in numerical order, in lots of 50 to 100, using an ordinary heavy file folder for cover, clamping the invoice to the folder.

The detail cost record is used for recording in detail the distribution of costs among the main accounts as shown on invoice register.

The accounts payable (or vendors' accounts) record is used for the recording of all invoices from vendors. After the invoices have been entered in the invoice register and detail cost record book, they are entered as a credit to vendor in accounts payable. Each vendor has a separate page or sheet. After entry is made, it is placed in file under vendor's name until ready for payment. When payment is made, same is vouchered and charged to accounts payable (vendors' account) and cash credited.

Issuance of purchase order (in quadruplicate).—The original of order is sent to vendor, the duplicate is filed numerically (which forms order register), triplicate is filed in open order file (vendor's name order), and quadruplicate (which forms material receipt or tally sheet) is filed by the office material clerk awaiting receipt of material.

Receipt of material.—Upon receipt of materials, the office material clerk checks and signs the material receipt portion of the order and files completely with supporting delivery tickets, etc., awaiting invoices.

Checking and auditing invoices.—Invoice upon receipt is checked against material receipt or tally sheet for receipt of material. Extensions, prices and footings are checked and certified. Cost distribution is checked and entered. Invoice is then audited for discount and cost distribution and certified. Invoice then passes to the superintendent for his approval and the approval of the owner's representative.

Entry of approved invoices in invoice register and vendor's account.—Upon return of approved invoice from the superintendent, the bookkeeper gives the invoice numerical register number and enters in the invoice register. Only fully approved invoices are given register number. Invoice is then posted to the credit of the vendor in accounts payable account and are charged in the detail cost record.

Journalizing accumulated totals of invoices registered to ledger.—Accumulated totals in the invoice register are journalized in the ledger (which is also the voucher record)

at daily, weekly or semi-monthly periods as is found practical.

Voucher check.—We have found the voucher check system to be the most convenient. The voucher is made in quadruplicate at the construction office on the job and the approval of the owner's representative is often indicated on all copies of the voucher. The check, or original voucher goes to the vendor, the duplicate to our general office for our records, the triplicate is kept as the job record and the quadruplicate is the "owner's copy," which is forwarded to the vendor with original to be receipted by him and returned. At intervals we furnish the owner with statement showing vouchers paid and receipted vouchers attached.

Since the major purpose of cost accounting is to give an adequate basis for future estimating, it is important that so far as practicable the form of cost accounting shall follow the form of estimate. This is not practicable to the last subdivision of each of the general accounts, but sufficient to permit intelligent use of all cost figures. With such figures it is possible to compare not only final costs, but costs at any stage of the job, with the original estimated cost for that portion of the contract. We frequently divide our estimate by floors, in the case of a many-storied building, in order to have a check upon quantities and upon expenditure at several stages of the work.

Distribution of Accounts

We use the decimal system of classification of accounts. The classifications number 100 to 600 inclusive and 900 are for our general books, which embrace the assets and liabilities, revenues and income accounts (we will omit these in our discussion). The general distribution is under the following headings:—

710 Excavation	810 Field overhead
720 Caissons	820 Extra work
730 Footings	830 Subcontracts
740 Trench and wall	840 (Subcontract) extra work
750 Concrete and fireproofing	
760 Masonry	850
770 Carpentry	860
780	870 Repair contracts
790	880
800 Plant expense	890 Company expense (not chargeable to owner)

The sub-divisions of headings 710-790 are between the items labor (1), material (2), and liability insurance (3). Thus labor in excavation would be 711, material in excavation 712 and liability insurance in excavation 713. A further division of the various kinds of labor and materials is made. The following classifications illustrate this point:—

Labor—711	Material—712
711.01 Digging (general)	712.01 Lumber
711.02 Digging sub-basement	712.02 Underpinning adjacent buildings
711.03 Sheeting and bracing banks	712.03 Rings (steel)
711.04 Shoring adjacent buildings	712.04 Cement

For convenience we have listed the charges of labor and material in the order they usually appear in building construction costs:—

Labor	Material
.01 Digging (general)	.01 Lumber
.02 Digging sub-basement	.02 Underpinning adjacent buildings
.03 Sheeting and bracing banks	.03 Rings (steel)
.04 Shoring adjacent buildings	.04 Cement
.05 Underpinning adjacent buildings	.05 Sand
.06 Pumping	.06 Stone
.07 Back-filling and grading	.07 Brick
.08 Cutting old footings	.08 Wall tie and inserts
.09	.09 Steel (structural)
.10 Placing lagging and rings	.10 Steel (reinforcing)
.11 Ventilating	.11 Nails and wire
.12 Mixing and placing concrete	.12 Clamps, purchased or rented
.13 Building forms general	.13 Tile
.14 Building forms exterior columns	.14 Protection (lumber, etc.)
.15 Building forms interior columns	.15 Terra cotta
.16 Building forms spandrels	.16 Granite
.23 Lay brick	.25 Frames and sash
.26 Bend steel	.30 Interior trim
.35 Set cut stone	.35 Coping
.44 Fit and hang doors	
.56 Unload and handle material, etc.	
.60 Clean up rubbish	

Add as many new accounts as are needed.

Should charges be made in connection with concrete and fireproofing under subdivision 750, they would follow the same order as in excavation:—

751.12 (Labor) mixing and placing concrete
752.04 (Material) cement
753 Liability insurance

Or, carpentry, sub-division 770:—

771.44 (Labor) fit and hang doors
772.25 (Material) frames and sash
773 Liability insurance

Classification of Plant Expense

Sub-division 800 covers plant expense and conforms with the sub-classification of the 700 accounts as much as practicable. The following are the headings under 800:—

801 Excavation	806 Masonry
802 Caissons	807
803 Footings	808
804 Sawmill	809 General (items charged to general equipment)
805 Concrete and fireproofing	

A further typical subdivision of the accounts under this heading is:—

801 Excavation	801.3 Equipment on charge and credit basis
801.1 Transportation (of equipment plant)	801.31 Labor
801.2 Erection of equipment	801.32 Material
801.21 Labor	801.4 Rental of equipment
801.22 Material	801.5 Fuel, lubricants and power
	801.6 Repairs

Should charges to plant in connection with concrete and fireproofing be made, they would be charged as 805 with divisions shown above.

Field Overhead

811—Salaries, general labor and expense	*812—Engineering expenses*
811.1 Superintendent and engineers	812.1 Plans, detail and engineering supplies
.2 Office employees	.2 Photographs
.3 Material men and timekeepers	.3 Engineering service
.4 Laying out building	.4 Architects' fees
.5 Watchman	
.6 Waterboys	
.7 Toolmen	
.8 Liability insurance, superintendent and watchman	
.9 Travelling expenses, superintendent, engineers, and office men	

813—Office expense	
813.1 Rent, light and heat	.6 Rent on adding machine and typewriters
.2 Stationery and printing	.7 Furniture
.3 Telephone	.8
.4 Telegraph	.9 Miscellaneous office expense, towels, etc.
.5 Postage and express	

814—Other fixed expenses
814.1 Bonds (maintenance and construction)
.2 Permits and licenses, boiler inspection
.3 Fire insurance
.4 Legal services
.5 Burglar insurance
.6 Association dues
.7 Advertisements
.8 Floor tests
.9 Ring tests

816—Temporary structure (labor and material)
816.1 Offices
.2 Toilets
.3 Toolhouse, blacksmith shops, storage sheds, etc.
.4 Stairs and ladders
.5 Fences, sidewalks, covers and other enclosures
.6 Temporary platform and driveways
.7
.8 Repairs and protection to adjacent property
.9 Protection to public utilities

818—Temporary light, heat and power
818.1 Light .2 Heat .3 Power

819—General cleaning
819.1 Labor .2 Teaming

820—Extra work
821.1 Use as many numbers as account charged

830—Subcontracts
831 Wrecking, excavating, shoring, etc.
831.1 Wrecking, contract
.2 Excavation, contract
.3 Shoring, contract
832—Heating, plumbing, wiring, elevators, etc.
832.1 Sub-heading for each kind of subcontract
833—Interior construction
834—Painting and glazing
835—Millwork
836—Roofing
837—Fireproof doors and windows
838—Interior finish
839—Structural steel

840—(Extra work) subcontracts.
841 Sub-headings for each kind of work done

870 Repair contracts (for small jobbing contracts)

890—Company expense (not charged to owners)
891 Sub-headings for each kind of expense

Statement of Construction Cost

At stated periods we take from he cost records a summary and de- ail statement of construction costs n the following form:—

Acct. No.	Name of Acct.	Item	Amount	Cost per Unit	Est. Cost	Diff.

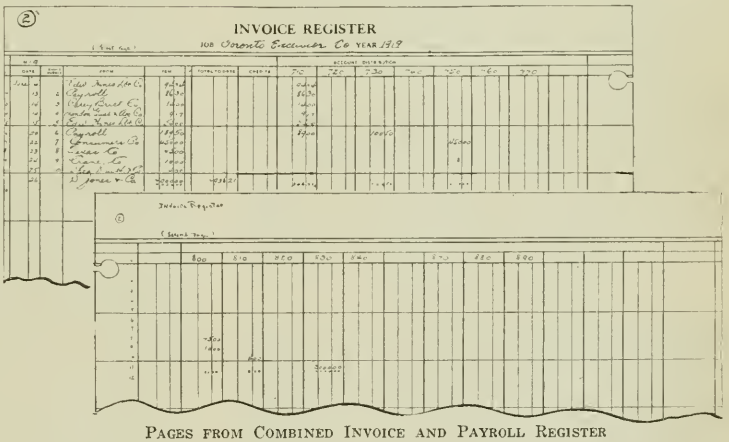
The last column is in black or ed; naturally the red items will ave careful scrutiny to ascertain hy costs are running above esti- ate. This statement is primarily or our own use, but the owner may ave a copy if he wishes.

Owner Knows Total Expenditure

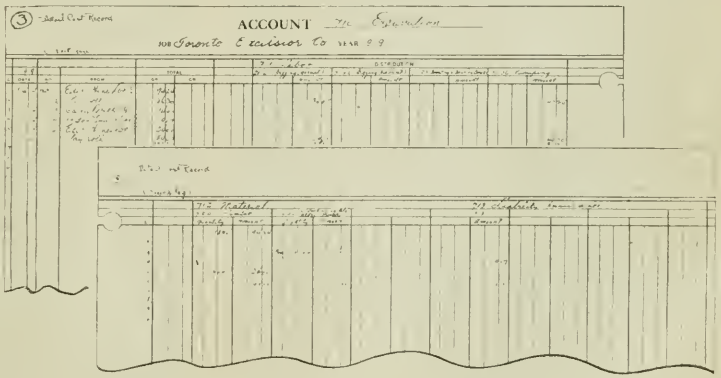
Under the cost-plus-fixed-fee ontract, the owner generally rnishes the funds to finance the ontract. We maintain an entirely parate bank account for each cost- us contract, representing the own- 's funds, and where agreeable to the owner, we arrange for the owner's representative to countersign all checks drawn by us on this account. At the start of the work we furnish to the owner an estimate of the anticipated amount of labor and material bills covering an initial period of two weeks or more, and the owner then advances the funds to cover these requirements. When the owner's receipted copies of vouchers covering this period are returned from the vendors, a statement is given to the owner showing amounts actually paid for payrolls, materials and sub-contract work, with receipted vouchers attached. That total is then credited to us by the owner on account of contract.

The advantages of having all accounts handled at the job are apparent. The distribution, if not clear from the purchase order, can be referred to the superintendent and the fact that the books of accounts are at all times open for the owner's inspection, is an assurance to him of honest treatment. The fact that he approves purchases of materials before made and again has the opportunity of questioning invoices prior to payment, leaves the control with him and prevents the accumulation of minor, disputed items, which if left for settlement until the completion of the contract, might not be readily explained.

But a system of accounts, no matter how perfect, cannot influence the cost of work except as it points out from time to time divergence from the preliminary estimate, the assumption being made that such differences are promptly taken in hand, the reasons investigated and the remedy applied. The success of work under the cost-plus contract



Pages from Combined Invoice and Payroll Register

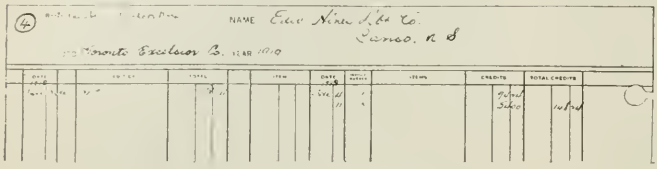


Pages from Detail Cost Record

is still dependent upon the integrity of the contractor and his ability to perform.

We have used this system of accounting with entire satisfaction to the firms mentioned above and many others, and we are now engaged in work at Halifax, N.S., on this same basis. This is adequate proof that the cost-plus contract is workable and that the owners not only feel safe but prefer this method because under it 90% of the savings under the preliminary estimate accrue to the owner, because the 10% retained by the contractor is a reasonable incentive to make every possible saving, and because additional costs incurred through no fault or omission of the contractor are rightly chargeable against the owner and should not reduce or wipe out the contractor's profit.

There is incentive for the contractor to make all possible savings under both old and new contract, and some of the savings must go to the contractor to give him that incentive; 10% is adequate and the 90% going to the owner builds a good-will account which practically assures repeat orders as new work becomes necessary. The building of a relationship which will ensure repeat orders is just as important in contracting as in merchandising.



PAGE FROM ACCOUNTS PAYABLE RECORD

The Engineer's Library

GENERAL LECTURES ON ELECTRICAL ENGINEERING

REVIEWED BY A. H. HULL
Assistant Electrical Engineer, Hydro-Electric Power Commission of Ontario

By Dr. Charles Proteus Steinmetz. Published by the McGraw-Hill Book Co., Inc., New York City. Fifth edition; 248 pages; 6 by 9 ins.; illustrated. Price, $2.50.

This book is a collection of eighteen lectures dealing with direct and alternating current distribution, effect of load factor on the cost of power, generation and generator wave form, hunting of synchronous machines, transmission, oscillations and surges, and lightning protection.

Three lectures are devoted to electric railways and railway motors. Electrochemistry, arc lighting and incandescent lamps are treated in separate lectures.

The last lecture deals with the use of power limiting reactors in large systems. Two appendices are included, the first being part of an address before the Franklin Institute in 1914, on the effect of electrical engineering on modern civilization. The second consists only of a table of resistances and reactances for overhead wires and seems to be entirely out of place in the book.

The lectures are free of mathematics, the subjects being treated in a general descriptive manner. While the book does not attempt to cover the entire field of electrical engineering, a careful reading of it will give the advanced engineering student, or the young engineer, a comprehensive general outline of that part of electrical engineering that has to deal with the problems of generation, transmission, distribution and utilization of electric energy.

Save for the next "Victory Loan." Your money is needed to ensure national prosperity.

RELATION BETWEEN WATER SUPPLY AND GOITER

AN apparent connection between goiter and water supply in various parts of the world is traced by Mayo Tolman, chief engineer of the West Virginia State Department of Health, Charleston, W. Va., writing in the "American Journal of Public Health."

Goiter, which manifests itself as an enlargement of the thyroid gland, shows high endemicity in Switzerland, parts of France, and in regions in every continent. In North America the main endemic centres are in parts of New Hampshire, New York, the Blue Ridge Mountains of Virginia, nearly all of West Virginia, the region about the Great Lakes, and Edmonton, Alt. Recent studies by Mr. Tolman indicate that there are 12,000 cases in West Virginia, while in Broxton County a house-to-house survey showed 1,148 cases, or 1 to every 20 inhabitants.

The cause of the disease is most generally attributed to the character of the drinking water. Efforts to connect the disease with various inorganic impurities in the waters of the region have not been successful, Mr. Tolman states. The relation seems to be with the geological ages of the rocks of the regions.

"Apparently," Mr. Tolman says, "volvanic formations, the crystalline rocks of the Archaic period and all deposits laid down in fresh water, are free from the goiter-producing characteristic." In the United States the greatest endemicity is found in paleozoic areas. In West Virginia water from the coal measures seems to cause the disease, while in the same valleys people taking water from higher in the mountains, above the coal measures, have less goiter as the elevation increases.

"This association of goiter with certain geologic time," says Mr. Tolman, "would indicate that the disease is not caused by a living organism, but is due to some substance derived from marine animals in past time. What this substance is, is not known, but experiments indicate that it is not retained by a Berkefeld, and that its goiter-producing property is destroyed by heating to 70 deg. C. It is, of course, possible that goiter is a deficiency disease, that the marine animals of geologic time used up a certain substance in the water that is essential to animal economy. This theory is severely shaken, however, by the fact that heat evidently destroys the goiter-producing element, but nevertheless it should not be entirely abandoned at the present stage of our knowledge.

"Goiter presents phases that should be of interest to health officers in those areas in which it occurs, and it is to be hoped that the disease will be given more study in order that its cause may be definitely determined, for without accurate knowledge of the cause of a disease, any measures to combat it may be hit-or-miss. There can be little doubt that the efficiency of a community is lowered by endemic goiter; consequently the spread of the disease should be prevented."

The first general meeting of the Canadian Association of British Manufacturers and their representatives was held September 8th in Toronto. John Wilson presided, and pointed out that the 55 members of the association represent over 300 British manufacturers. The association hopes to have a representative in London, and that in time it will become as large as the C.M.A. Trade sections of the association were formed, and the chairmen will form a publicity committee. The appointment of tariff and transportation committees are to be looked after by the executive committee. F. W. Field, trade commissioner, reported that the British trade commissioners in Canada have been granted authority by the department of trade and commerce to appoint an expert to deal with all matters of dispute in regard to quality of goods. Capt. John Harris stated that there are in Toronto 250 representatives of British firms.

USEFULNESS OF VEGETATION IN MARITIME ENGINEERING*

By E. T. P. Shewen, M.E.I.C.
Consulting Engineer, Public Works Department of Canada, St. John, N.B.

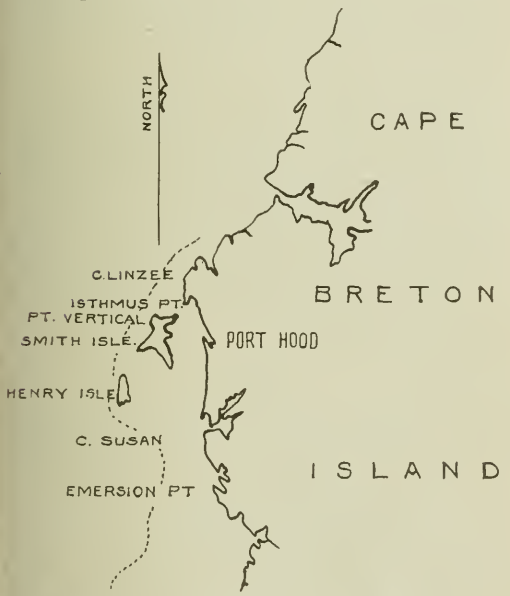
"BRITISH engineers have perhaps been somewhat apt to disregard those transformations which are capable of being brought about by vegetation."

This remark is found in the preface to a book recently published, entitled "Tidal Lands: A Study of Shore Problems" (1918), by A. E. Carey, of London, Eng., and F. W. Oliver, professor of botany in University College, London, Eng.

A convincing illustration of the value of vegetation as a protection against inroads of the sea, was given about ninety years ago in the maritime provinces, by the destruction of a fine harbor at Port Hood, on the west coast of Cape Breton.

Port Hood Harbor

This shelter, 2 miles long and 1¼ miles broad, was formed by the junction with the mainland of Smith's (or Port Hood) Island, which constituted the western barrier, presenting on the east a concave side. From Emersion Point, 4 miles below the harbor, to Dean Shoals, abreast the middle of the island, the coast lies north and south but then trends N.N.W. for 1½ miles to Isthmus Point, there turning due north to Cape Linzee, ½ mile away. At Cape Linzee, the shore swings N.N.E., and continues in that direction almost in a straight line for some miles.



Map Showing Cape Breton Coast Line in the Vicinity of Port Hood

The connection was made by a sand beach, or bar, starting from the shore at Isthmus Point and running nearly ¾ mile S.S.W. to the head of the island.

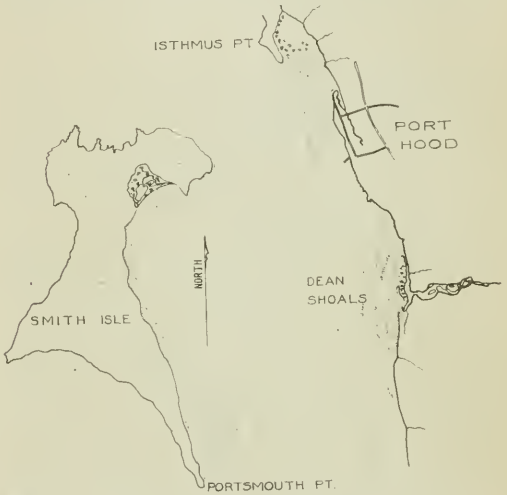
In respect to the littoral drift which made the isthmus, it is worth noting that the line of it, if produced N.N.E., practically coincides with the coast-line for 10 miles from Cape Linzee.

*Paper read at the fifth professional meeting of the Engineering Institute of Canada, September 10th to 12th, 1919, St. John, N.B.

A deep and capacious haven was thus made between the island and the main, large enough to hold a fleet, and affording at best more than seven fathoms of water. Concerning the holding-ground, there is no present information, for the bottom was covered with sand and the depth shoaled when the isthmus was washed away. The harbor was open to the south alone, and in that quarter the fetch is only 21 miles to the Nova Scotian coast. The conditions of a good, natural harbor were therefore fairly fulfilled.

The isthmus was covered with grass, so long, according to statements made a quarter of a century ago by some of the older people of the place, that the children who had to cross to reach the school, used to play hide-and-seek in it on the way.

Unfortunately, cattle were turned out there to graze, and disaster followed. One of the eye-witnesses of the consequent destruction of the sand beach (and from his apparent age, one of the school-children mentioned), said that he considered the greater damage was done by the hoofs of the cattle in uprooting, and that the actual cropping was a minor evil. In any case, the grass was killed by the cattle, and the sand above high-water, no longer held in place by the roots or protected by the stalks, was blown away by the wind until the crest of the beach, formerly several feet above high water, was soon lowered to that level. A breach, small at first, was shortly after made by the sea.



Map Showing Dean Shoals and the Sand Bars That Have Formed in Port Hood Harbor

Isthmus Swept Away

Seeing an opportunity for making a navigable outlet which would save a long sail round the tail of the island in reaching the northern waters, the fishermen enlarged the breach to a size sufficient for a boat-channel. The sea did the rest. Not long afterwards the whole isthmus was swept away, the harbor utterly destroyed, and only an open roadstead left in place of it.

The grass which had preserved the harbor for an unknown period by holding the sand composing the northern bulwark, was evidently a valuable and hardy species, consequently about twenty years ago search was made to find if any of it had survived in some sheltered nook lower down the shore, where the sand and roots must have been carried (part of the sand lodged on Dean Shoals) since the littoral drift follows that direction.

In a cove filled with sand, some distance to the south, grass of the same kind was discovered in quantity, and on being sent to the Experimental Farm for examination, it was

pronounced to be *calamagrostis arenaria*. It was then decided to plant some of it at Negropoint in order to stop the dry sand drift at that time being blown over the top of the work into the harbor of St. John, and also in order to assist the increase of the natural face on the weather side of the breakwater pending its extension to Partridge Island.

Transportation from Cape Breton did not become necessary, for the resemblance of the grass at the head of Courtenay Bay to the Port Hood specimens was observed, and they were found to be identical. Roots were accordingly transplanted from Courtenay Bay to Negropoint, and the desired effect was produced.

On the sandy eastern coast of New Brunswick, and on the shores of Nova Scotia and Prince Edward Island, opportunities occur for the use of this grass, and wherever accumulation of sand is observed to be taking place alongside a new work, it might be prudent, for the purpose of retarding the formation of dunes, to plant it as soon as the littoral drift collected rises a few feet above tide-level.

Advantageous Uses for Grass

If erection of the long piers at Cape Traverse in Prince Edward Island, and at Richibucto in this province, did not actually originate formation of the dunes at those places, it at least contributed to increase their size, because both works caused advances of the foreshore. According to the authors of "Tidal Lands," dunes can be formed as soon as the sand flats of the foreshore rise high enough to allow the surface to become sufficiently dried between tides for the wind to blow the thin dry layer landward.

At Cape Tormentine, on this side of Northumberland Strait, there are wide sand flats dry for a considerable period of each tide, but no dunes, because the prevailing strong wind blowing up the Bay of Fundy and across the low isthmus of Chignecto is off-shore from the New Brunswick coast.

Dunes, are, however, found at Cape Traverse on the opposite side of the strait and nine miles distant, where the same wind is on-shore, and where the sand flats as already mentioned were enlarged by the construction of a long railway pier of solid cribwork So rapid was the spread of the strand there, that the workmen said the sand came out to the end as soon as the pier was built. Quantities travelled round the end and, lodging under the lee, went on either to make or augment the dunes on the farther side of the cove.

At Mabou, ten miles north of Port Hood and on the same coast, dunes have overwhelmed the land, killing the trees and all other vegetation.

The dunes at Richibucto are formed on waste or inferior land, and in consequence have so far caused little damage.

In such places, *calamagrostis arenaria* might be cultivated with advantage. No doubt other varieties of shore plants, useful in greater or less degree for holding or protecting by root or top the dry sand, might be discovered on the shores of these provinces.

The lessons taught by the catastrophe of Port Hood are evidently:—

Lessons Taught by Catastrophe

(1)—To preserve the useful shore grasses, in particular by the exclusion of livestock from beaches.

(2)—To plant *calamagrostis arenaria* betimes, when sand-spits or beaches are being denuded by wind action.

Wherever a breach in the numerous dry sand bars found in this region is being made, after restoring the beach to proper height for survival of the roots, the engineer would act wisely in planting bent-grass.

Movement of the dunes on the European and also on the Australian continents, is being prevented by systematically setting, according to prescribed rules, roots of this grass as a first step, followed by cultivation of other suitable plants as the dunes become fixed.

Botanical investigation of the sandy coasts of Canada, with the view of ascertaining the different kinds of indigenous plants capable of holding sand, which flourish best at varied elevation above high-water (say from 10 ft. to 60 ft.), would furnish information useful to the maritime engineer in hindering the development of sand dunes or in arresting their movement when formed.

PRESSURES IN PENSTOCKS CAUSED BY THE GRADUAL CLOSING OF TURBINE GATES*

By Eugene Halmos
Designing Engineer, Barclay Parsons & Klapp, New York

EVER since the publication of the paper† entitled "Penstock and Surge-Tank Problems" by Minton M. Warren, the writer has hoped that some one would point out the injustice done to one of the greatest hydraulic engineers of the present age by the form of, and the comments appended to, Mr. Warren's presentation of what he termed "Alliévi's formula."

Unfortunately, Mr. Warren has not been corrected. This formula was accepted by American engineers as representing Alliévi's solution of the problem of water-hammer in pipe lines, and, consequently, it has been severely criticized and misinterpreted.

The value of Mr. Gibson's excellent paper is also seriously impaired by the references, both in the text and in the diagrams, to "Alliévi's formula" as taken from Mr. Warren's paper, and the writer would suggest that, after perusal of the following, Mr. Gibson omit all reference to Alliévi, except to state that his solution agrees, in every particular, with that of Alliévi.

The writer proposes to submit a brief summary of Mr. Alliévi's formulas, which, in his judgment, represent a complete solution of water-hammer problems as regards determination of the pressure at the gate or at any other section of the conduit, at any instant, and under any conditions of closure and physical characteristics of the plant. It is more general than Mr. Gibson's solution, inasmuch as it also includes the determination of the pressure variations after the stopping of the gate movement, and as it gives a method of estimating the interval in which the pressure maximum will occur.

As the present paper and the previous ones deal almost exclusively with the case of water-hammer during the closure of gates, and with the variation of the pressure at or near the gates, the writer will only quote Alliévi with regard to formulas applicable to such cases. The writer, however, intends to translate Alliévi's book into English, which, it is hoped, will be of great help to designers of hydraulic plants and apparatus.

In the following, the formulas representing the relation of time and pressure are given for three phases, namely,

the first phase, for which $t \leqq 2L/a$;
the second phase, for values of t beginning with $t=2L/a$ and ending at T;
and the third phase, $t>T$.

Notation

a = velocity of propagation of pressure along pipe;
c_0 = uniform velocity of water in pipe before beginning of gate closure;
C = variable velocity of water in pipe at any instant during gate closure;
u_0 = uniform velocity of water through gate orifice before beginning of closure;
u = variable velocity of water through gate orifice during gate closure;
t = time, in seconds, recorded from beginning of gate movement;
T = duration of gate movement, assumed to be continuous;
L = length of pipe conduit;
y_0 = pressure head on pipe line at gate before closing begins;
y = variable head at gate due to closure.

General Formulas

(1) *Variation of Pressure Head During and After the Closing Motion of the Gates.*—

*Discussion (presented to the American Society of Civil Engineers) of Norman R. Gibson's paper (see September 4th and 11th issues of *The Canadian Engineer*).

†"Transactions," Am. Soc. C.E., Vol. LXXIX, p. 238.

First phase, $t \leqq 2L/a$.

For this interval, the pressure head, y, at any instant can be computed from the equation.

$$y^2 - 2y[H + a^2\psi^2(t)/g] + H^2 = 0 \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

in which $H = y_0 + ac_0/g$

and $\psi(t)$ is the ratio of the instantaneous area of discharge to the area of the gate opening at the time, $t = 0$, the value of $\psi(t)$ being taken at the instant for which the pressure head, y, is calculated.

It will be noted that if the gate is closed in a time, $T \leqq 2L/a$, $\psi(T) = 0$, and the equation reduces to

$$y^2 - 2Hy + H^2 = 0$$

$$y = H = y_0 + ac_0 g \quad \ldots\ldots\ldots\ldots (2)$$

which shows that in such a case the maximum pressure head is independent of the actual length of the time of closure.

Of the two roots of Equation (1) one is greater, the other is smaller, than H. This latter is the true value of the pressure head at any instant.

Second phase, $2L/a \leqq t \leqq T$.

During this period of the gate movement, the following equation applies for the determination of the pressure head at any instant:

$$y^2 - 2y[H - 2f + a^2\psi^2(t)/g] + (H - 2f)^2 = 0 \quad \ldots\ldots\ldots (3)$$

Of the two roots of Equation (3), that giving the smaller value should be used.

It will be noted that this equation differs from Equation (1) only in so far that, instead of H in the latter, $(H - 2f)$ appears in Equation (3).

The values of the function, f, should be determined in the following manner:—

For the interval, $0 < t < 2L/a$, $y - y_0 = F(t)$, y being calculated from Equation (1).

The velocity, C, in the conduit (at the gate) can be computed from the equation

$$y + (a/g)C = H$$

for this interval.

For the interval, $2L/a < t \leqq 4L/a$; $f = F(t - 2L/a)$; in other words, the values of $F(t)$ found in the first interval should be substituted for f in Equation (3) to obtain the value of y for every subdivision of the second interval. Then the corresponding values of the velocity, C, may be found by $y + (a/g)C = H - 2f$, and the value of $F(t)$ for the second interval by $F(t) = (a/g)(c_0 - C) - f$.

For the third interval, $4L/a < t \leqq 6L/a$, the values of $F(t)$ so found for the subdivisions of the second interval should be substituted for f in Equation (3) to get y, and so on, for all subsequent intervals until the gate has stopped moving or has become entirely closed.

Third phase, $t > T$.

If the movement of the gate is stopped at an instant such that $t_1 < 2L/a$, the pressure head, y, remains constant until $t = 2L/a$. From this instant on, or from the time of the stoppage, in the case, $t_1 > 2L/a$, there is developed a hydrodynamic phenomenon in the form of an asymptotical approach of the pressure head, y, to the new constant head, y_0, of uniform flow. There are three different cases.

First.—If $a\psi(t_1) > u_0 + u_1/2$, in which case y approaches y_0 without oscillations.

Second.—If $a\psi(t_1) < u_0 + u_1/2$, in which case y approaches y_0 through oscillations of diminishing amplitude.

Third.—If the gate is entirely closed, $\psi(t_1) = 0$, the pressure head (disregarding the dampening effect of hydrodynamic friction) oscillates indefinitely, with a constant amplitude, between the value of y, which occurs at the instant of closing, and $2y_0 - y_3$, the amplitude being $y_3 - y_0$.

(2) *Estimating the Phase in Which the Maximum Pressure will Occur.*—Assuming a linear closure of the gates:

(a) If $ac_0 < 2gy_0$, then the pressure head at the end of the first phase ($t = 2L/a$) will always be greater than the average maximum pressure [found by Equation (4)] occurring during the second phase.

(b) If $2gy_0 < ac_0 < 3gy_0$, the maximum pressure head occurs either at the end of the first phase, or during the second phase, according to whether the closing time, T, is smaller or greater than $[ac_0 - gy_0)/(ac_0 - 2gy_0)](L/a)$.

(c) If $ac_0 > 3gy$, then the maximum pressure will always occur during the second phase and will be greater than that at the end of the first phase.

Equations (1), (2), and (3) are the general formulas derived by Alliévi, by the help of which complete pressure-time curves can be worked out for any assumed conditions of T, L, a, c_0, and y_0. The writer is very much pleased to state, that, by the use of these equations, he was able to check accurately all the curves presented by Mr. Gibson. He wishes to compliment the author in having found, quite independently, and by a simpler mathematical method than Alliévi's functional derivation, the correct formulas for the representation of pressure-time curves and related phenomena.

Special Formulas

It has been found by experiment, and by working out pressure-time curves for a great number of cases actually met in practice, that, on the assumption of linear gate closure:

(d) The pressure behind the gate remains practically constant for $2L/a < t \leqq T$ (y is not a function of time or $dy/dt = 0$ between these limits) and, therefore, for this period, the pressure is independent of the elastic qualities of the water and the conduit, in other words, independent of (a);

(e) The pressure is distributed in a linear way along the pipe;

(f) The velocity of the water, C, is the same at any instant at any section of the conduit $(dc/dx = 0)$.

Taking into consideration the observations noted under (d), (e), and (f), a good average value of y maximum during the second phase can be obtained by solving the equation

$$Z^2 - Z(n^2 + 2) + 1 = 0 \quad \ldots\ldots\ldots\ldots (4)$$

where $Z = y_{max}/y_0$ and $n = c_0 L/gTy_0$.

This equation is identical with Equation (C) in Mr. Warren's paper. In order that it should be valid, it is necessary:—

(1) That T be greater than $2L/a$;

(2) That the gate movement (the rate of reduction of the area of the outlet) be a linear function of the time;

(3) That, in case of partial closure, that value of T should be used which would be obtained if the gate should be completely closed at the same rate of speed;

(4) That the physical data, as L, a, y_0, and c_0, shall conform to those ordinarily met in practice.

In order that Equation (4) should produce the maximum pressure head obtaining during the whole movement of the gate, it is necessary that ac_0 shall take the values defined under (b) and (c).

It is evident that Mr. Warren committed a serious error by omitting the publication of Alliévi's general Equations (1), (2), and (3), and by omitting the proper definition of Equation (4) and the limitations of its applicability as defined by Alliévi.

The only ambiguity which may occur in using this formula is the lack of a better definition of Condition (4). This is extremely difficult, on account of the great number of variables entering into the problem. The writer, however, proposes without being able to give strict analytical proof at the present time, that Equation (4) should be used only, if

(α) $Lc_0/gTy_0 < \frac{1}{2}[ac_0/y_0g + y_0/(y_0 + ac_0/g) - 1]^{\frac{1}{2}}$; and,

(β) $ac_0 > 2gy_0$.

As L, c_0, a, and y_0 are dependent on rather unalterable physical conditions, if Condition (β) is satisfied, Condition (α) can be fulfilled by determining T according to the proposed formula.

If, besides Conditions (α) and (β), Conditions (b), (c), (1), and (2) are also fulfilled, Equation (4) will give the absolute maximum head at the gate during the movement of the apparatus.

It will be found that,

for $c_0 \leqq 10$ ft. per sec.

y_0 = between 100 ft. and 500 ft.

$T \leqq 6$ intervals,

all the foregoing conditions are fulfilled, which means that, in most practical cases, Equation (4) actually furnishes the maximum pressure head at the gate.

If the elasticity of the water and the conduit is neglected for the whole time of the movement of the gate, then, for the conditions for which Equation (4) is applicable, the pressure-time curve can be platted from the equation:

$$\log. \sqrt{[(u_0^2+u_R^2)^{1/2}+u-u_R][(u_0^2+u_R^2)^{1/2}-u_0+u_R] \div [(u_0^2+u_R^2)^{1/2}-u+u_R][(u_0^2+u_R^2)^{1/2}+u_0-u_R]} = [(u_0^2+u_R^2)^{1/2}-u_R] \log. [T(T-t)] \quad \ldots\ldots\ldots (5)$$

in which $u_R = K(t.T)$, where K is the ratio of the area of the gate opening at $t = 0$ to the area of the pipe, and $u_0 = (2gy_0)^{1/2}$, $u = (2gy)^{1/2}$.

This curve will have a maximum at $t = T$ if Conditions (b) and (c) are fulfilled, and will have a practically horizontal position in the second phase if Condition (a) is observed. It will differ very little from the true curve of pressure variations, and is applicable to practically the whole range of actual water-power problems.

It will be noted that Equations (4) and (5) are identical with Equations (6) and (7) given by R. D. Johnson in his discussion* of Mr. Warren's paper. Great credit is due to Mr. Johnson for having grasped correctly the essential features of this difficult subject, and for his wonderful mathematical skill in solving by independent methods the intricate problem of water-hammer.

In conclusion, the writer wishes to observe, that it would be desirable to encourage the use of Alliévi's, Gibson's, and Johnson's formulas for water-hammer, and to reject and discourage the use of other formulas, some of which, such as Mr. Warren's, are never true, not even accidentally.

*"Transactions," Am. Soc. C.E., Vol. LXXIX, p. 280.

JAPANESE DECISION ON TRADE MARKS

IN a suit instituted by a Philadelphia manufacturing company for the protection of its trade-mark rights, the Supreme Court of Japan has handed down a decision which upholds every essential of trade-mark rights guaranteed under Japan's treaty agreements with the United States and other countries. It places the spirit of the law of Japan on a plane equal to that occupied by western peoples, and it affects, directly and most favorably, manufacturing interests involving annual production on this continent amounting to billions of dollars.

The trade-mark concerned in the litigation is that of the Miller Lock Co., of Philadelphia. This trade-mark (a scroll containing the word "Miller"), was registered in the U. S. Patent Office, October 8th, 1906, and in 36 other countries, date of registration in Japan being March 26th, 1907.

The discovery was made in 1916 that the Crown Lock Co., of Tokyo, Japan, was manufacturing imitations of the Miller padlocks and stamping them with a facsimile scroll containing, in one instance, the word "Crown," and, in another, the word "Million."

Legal proceedings against the infringing company were begun in the Japanese Patent Office at Tokyo, and the fight undertaken with a resolve to end definitely, if possible, all invasions against trade-mark rights, was based upon the weakest aspect of the owners' contention. Instead of alleging infringement by the scroll containing the word "Million," they claimed redress against the infringement committed by means of the scroll containing the word "Crown."

The Miller Lock Co.'s averment, therefore, claimed practically on the scroll alone and risked much by its voluntary choice. But, on the other hand, it put squarely up to the administration of Japanese law and treaty rights the essential principles involved in trade-mark suits and called for a definition of unfair trade competition which must be on a par with the spirit and the administration of the law in the most advanced and just of western countries. In a word, the fight was not one wholly of self-interest; it was undertaken for the benefit of the world's trade and for Japan's welfare no less than that of other countries.

The most distinguished legal talent of Japan was engaged in the struggle, and court and patent office records were searched exhaustively for precedents.

The decision reached is made just as Japanese padlocks, bearing the alleged scroll, are invading Canada.

NEW ENGLAND WATER WORKS ASSOCIATION

FOLLOWING is the program of the thirty-eighth annual convention of the New England Water Works Association, to be held September 30th to October 3rd in Albany, N.Y.:—

"The Operation of and Purification Effected by the New Drifting Sand Filter System at Toronto," by Norman J. Howard, bacteriologist-in-charge, Filtration Plant Laboratory, Toronto.

"Swimming Pool Management," by William P. Mason, professor of chemistry, Rensselaer Polytechnic Institute, Troy, N.Y.

"The Supervision of Public Water Supplies by the New York State Department of Health," by Theodore Horton, chief engineer, New York State Department of Health, Albany, N.Y.

"Schoharie Development of the New York Water Supply," by J. Waldo Smith, chief engineer, Board of Water Supply, New York.

"Water Supplies for the American Expeditionary Forces," by Francis F. Longley, consulting engineer, New York.

"Watershed Leakage," by Robert E. Horton, consulting engineer, Voorheesville, N.Y.

"Hydraulic Fill Dams of the Miami Conservancy District," by H. S. R. McCurdy, division engineer, Miami Conservancy District, Englewood, O.

"The 10-Million Gallon Covered Reservoir of the Dayton Water Works," by Leonard Metcalf and William T. Barnes, consulting engineers, Boston.

"Dangerous Reduction to Insulation Resistance in High Presure Fire Service Motors Due to Moisture," by William W. Brush, deputy chief engineer, Department of Water Supply, Gas and Electricity, New York.

"Detection of Losses from Underground Piping Systems," by Paul Lanham, engineer in charge of waste detection, Washington, D.C.

"Experience in Metering Fire Services," by Frederic E. Beck, chief engineer, Consolidated Water Co., Utica, N.Y.

"Painting Standpipes," by Charles W. Sherman, consulting engineer, Boston.

"Pumping Engines for Small Water Works Plants," by Creed W. Fulton, of the Goulds Mfg. Co., Boston.

"Tests of the Uniflow Pumping Engine," by D. A. Decrow, of the Worthington Pump and Machinery Corporation, New York.

"Guarantees or Assessments for the Extension of Main Pipes," by Bertram Brewer, assistant engineer, State Department of Health, Boston.

A. E. Doucet, director of public works of the city of Montreal, recently recommended to the city council that the claims of Pion & Grothe and of T. Sullivan, formerly contractors for the La Salle Bridge, be settled by returning Mr. Sullivan's deposit of $21,000 and paying him about $6,300 additional, and by returning Pion & Grothe's deposit of $24,000 and paying them about $16,000 additional. Mr. Sullivan's claim was for $56,000 and Pion & Grothe's amounted to over $95,000. This suggested settlement has been rejected by the city councillors, who decided that it did not comply with the Act passed by the Quebec Legislature during the last session, which stipulates that the contractors be paid the value of the work they performed as at the time of performance, together with compensation for all outlays in connection with the contract, these amounts to be calculated without profit to the contractors. The Act stipulated that if a settlement were not made within six months, the city and the contractors were to refer the claims to arbitrators.

THE CASE AGAINST PAYMENT TO CONTRACTORS FOR ESTIMATING

By William Graves Smith
President, Quantity Survey Co., New York

[*General contractors have evidenced considerable interest in the "Nelson Form," the "Kelley System" and other proposed methods of paying contractors for the preparation of estimates. The "Committee on Methods" of the Associated General Contractors of America has requested statements, for purposes of investigation, from the promotors of the various proposed systems of payment, and from W. G. Smith, who is representing the interests of the quantity surveyors. The following is the statement that was recently submitted to the committee by Mr. Smith.*—Editor.]

CONTRACTORS are becoming restless. They are seeking relief from conditions that are recognized as unfavorable, and the very fact of the creation of a national organization shows that they are beginning to reason about the causes of discontent and to study how to improve matters.

One measure of relief proposed is the demand for payment for estimating. Another receiving considerable attention is the introduction of the quantity surveyor to supply uniform quantities as the basis of all bids. Before discussing them it will be well to consider some of the fundamental economic features of construction.

Fundamentals in Construction

It is the building owner who eventually pays for all expense. The overhead expense of architects and contractors, which covers miscellaneous expense of all sorts on projects that do not eventuate in contracts for them, is collected on the jobs for which they do receive contracts. Building owners, therefore, pay indirectly for all estimating and quantity expense.

Again, there should be a sharp distinction drawn between estimating expense and quantity expense. As used in this report, estimating expense will mean the expense of determining labor and material prices and everything else that enters into pricing up quantities of work to be done, except the expense for the preparation of quantities. This is considered as distinct from estimating expense.

Estimating is a part of a contractor's work that by no method can be satisfactorily delegated to any outsider. No method of payment for it can in any way relieve him of the necessity of doing it for himself and for assuming full responsibility for the prices he offers for doing the various kinds of work required under any contract. There is undoubtedly considerable confusion among contractors in discussing payment for estimating due to its close relation to quantity preparation, and by many it is considered as covering both matters. There can be no escape from estimating expense; but there are ways which will be explained to minimize quantity expense in a very desirable and satisfactory manner.

There is a sad misconception or disregard of "overhead" on the part of many contractors. Some say, for example, that estimating expense comes out of "profit." If a contractor does not know what percentage of his receipts goes to pay for rent, insurance, interest, salaries for estimators, etc., or doesn't care to account for these items in his estimates as "overhead," it is a matter for his choice and decision. But if he does not account for his "overhead" as a separate item in his bids, he should not complain if his so-called "profit" is reduced by payment of such items.

Competition vs. Speculation

There must be competition. Anything permitting or leading to the development of a building trust will be disastrous to the interests of the majority. On cost-plus work, even, there should be competition for a percentage contract among acceptable builders, to demonstrate their ability to give service. Service can only be measured ultimately in terms of cost. On the other hand, competition can only exist when uniform requirements are made the basis of competition. Anything else is speculation. Constructive ability and management should be the winning and determining factor. Until they are, and until a generally accepted minimum percentage of profit is demanded by all, the contractor's existence will continue to be a stormy one.

Anything that decreases a contractor's "overhead" or allows him to figure "costs" more accurately, or gives him better opportunity to demonstrate his superior constructive and executive ability, without increasing cost to the building owner, is a good thing for both parties.

Payment for Estimating

Direct payment for estimating would not reduce a contractor's expense for same. His overhead would not be reduced, for a contractor would not be furnished anything that would reduce his labor or lessen his responsibility. It would simply change the method of reimbursement and shift the burden of expense. Contractors that properly treat "overhead" as something separate from "profit" know that they collect in "overhead" all of their estimating expense from the jobs they win. The building owner that gives them a contract pays for the estimating on his own job and on an average for about fifteen or twenty others that his contractor has bid on and lost, or which did not go ahead.

This may seem a hardship to building owners, but looked at from this standpoint, it is not a hardship to contractors. There are, however, many reasons why estimating expense cannot be satisfactorily paid for job by job with any hope of the building owner reaping any benefit financially or otherwise.

In other business, estimating expense or pricing is recovered as an overhead item. Take for example the simple transaction of buying the winter's supply of coal. A coal dealer doesn't charge a separate fee for giving a price for coal delivered at your residence. He has computed the cost to unload and store the coal. He knows what it costs on an average to haul coal within the radius of his district. You don't expect him to figure out a price for you at so much per ton-mile for delivery at your door and to pay him for making the estimate. No; when you ask a price for a definite amount of coal you expect him to name his price. What it costs him to figure a price you are not interested in. If he set an estimating charge you couldn't tell whether it was fair or not. You wouldn't care to be bothered with separate payments and wouldn't expect that it would result in any economy to you if the coal dealers adopted such a practice.

This example of the coal transaction should point out an important difference in the contracting business. Quantity data is furnished to the coal dealer and he names his price. In contracting, bidders have been doing both the quantity work and the pricing or estimating work. The coal dealer assumes no responsibility as to the amount of coal required. It is your responsibility to order enough to keep you warm during the winter. Contractors, however, have been assuming responsibility for all their quantity work when making bids.

Objections to "Payment"

There are many obstacles in the way of collecting estimating expense job by job. Who is going to determine the proper estimating fee for various classes and sizes of jobs? A uniform rate would not apply to all jobs or to all contractors.

Who is going to pay the fee? the owner, or the architect, or will it be collected and paid through a broker acting for the bidders? If paid by the owner or architect, he will expect all bidders to meet the lowest fee accepted by any bidder. Contractors intent on bidding won't hesitate to bid on that account. They will add the difference to their bids if the fee paid seems too small. That would put matters back where they are now. If collected and paid through a broker acting for the bidders, unless the sanction of the architect and owner is obtained, an injustice is done the owner. If the owner must pay he should know to whom he is paying estimating fees and how many. He will be interested to know what it is costing him.

How are the sub-contractors to receive separate payment for their estimating expense? If it is good for the general contractor, it ought to be extended to the "subs." If a fee

large enough to reimburse the "subs" is paid to the general contractor, what assurance is there that it will be fairly divided among the "subs"? On the other hand might not the "subs" victimize the general contractor by collecting their full allowance from each and all of the general contractors to whom they tendered a bid for any job?

What effect would it have on competition? It would stifle competition. An owner would choose to pay for a minimum number of estimates. It would foster formation of a building trust which could be applied to for all estimates. That, it is useless to say, would not benefit the majority of contractors.

"Bidding" for the Payment

How would an architect or owner know what group of contractors to pay for estimates? They know that some contractors will consider their job attractive and be really desirous of competing for it, but how can they know whom they are? Any contractor, with very little labor, can name a price that would guarantee a fine profit, and some might be tempted to do so if paid $200 or $500 or more for the few hours' labor required to make the estimate. But will that satisfy a building owner or an architect? Is it good business?

If competition is kept open, what will prevent anyone from going into the business of making estimates based on cubage, or some other short-cut method, and collecting the estimating fee?

Contractors would continually know of jobs that they would like to bid upon, but had not been offered an estimating charge for doing so. Do you think that would stop them from bidding, or would stop an architect or owner from considering their bids if they were responsible parties? Most certainly not; and if an owner could get good bids without separate payment for estimating expense, do you think he will pay for others that would be no better?

The contradictory situation would arise where a contractor who wanted to figure a job would beg for the opportunity and at the same time demand to be paid for the privilege.

Quantity Expense Real Factor

True estimating expense, separated and not confused with quantity expense, is a small matter. It is better left as an item of overhead. Estimating cannot be delegated to an outsider. It is too personal, and comprehends the assumption of risks and responsibility based on experience and judgment. Consequently, leave it in overhead, along with rent, interest, bad bills, etc. There is no more reason for separating estimating on buildings than there is to separate the coal dealer's estimating expense from the price of a ton of coal.

It is true that contractors cannot, under prevailing methods, give a price for a building as simply as a dealer can for coal. He must find out what is going into a building. That involves the matter of quantity expense and the risks carried therewith. An analysis of that part of a contractor's work will develop the real reason for the demand and agitation for relief, and will dispel some of the confusion that exists.

The liquidator of the defunct Rock and Power Machinery Ltd. has made his final report, in which he announces that $11,767 has been paid on secured and preferred claims, but that there will be no dividend whatever for ordinary creditors. The principal asset available for ordinary creditors was a contract with the Kennedy Engineering Co., he states, but as the creditors declined to furnish the necessary funds for litigation, the claim was abandoned.

The executive committee of the American Association of Engineers has rendered a decision that the constitution of the association does not prohibit the admission of architects, and announces that the applications of architects will now be considered as having the same status as applications from engineers. Those architects who have previously applied for membership and whose applications could not be accepted on account of the apparent exclusion of architects by the constitution, may re-enter their applications for membership.

HIGHWAYS TO LOWER THE HIGH COST OF LIVING

By John S. Beall
President, Armco Iron Culvert & Flume Manufacturers' Association

To say that unimproved roads increase the cost of living is to give a reason without a remedy. Economists are raising their voices against waste and mismanagement, both of which undoubtedly add to the fast-mounting cost of everything we eat and wear. To-day, we hear that blame should be placed upon the middleman; yesterday the effect of the world war was proclaimed the reason for high prices; tomorrow we will hear that the high cost of everything is due to some other single cause. But in my opinion, the high cost of living to-day is due to a combination of causes, no one of which is altogether to blame.

When we consider that following every great war, with its necessarily vast destruction of property and slowing up of production, prices rise and the cost of living consequently increases beyond the income of the average person, we must look behind the alleged causes which are to-day said to be making prices high, and get down to the fundamental causes which made living higher than it should have been before the great social and economic disturbance which resulted from the world conflict. In other words, we must find out what made living as high as it was before 1914.

Trucks Compete with Railroads

People never kick about the price of a thing if they can afford to buy it. It is only when the price of a commodity rises beyond the amount of money they can afford to pay for that commodity that we hear cries of profiteering and witness social unrest, such as is sweeping the country to-day.

The last fifty years have seen the growth of huge cities in the central west and west, and a consequent concentration of population in these cities. Where eggs were six cents a dozen fifty years ago, they now cost fifty-six cents. Where they were eaten fresh from the barnyard fifty years ago, they are to-day transported to cities, placed in cold storage and later, months later, sold to the consumer when he has fifty-six cents which he can afford to devote to the purchase of this food. The farmer who once "drove to town" with his load of eggs, has now been pushed, by the growth of cities, many miles from the city markets and depends upon the railroads to carry his product to where he can receive a high enough price to allow him to carry on his farming business and supply himself and his family with the necessities of life—necessities he cannot himself produce, if he is to maintain his farm at its maximum production.

Just as the railroad seemed to make the farmer independent of the highway, so is the motor truck developing to make the producer of foodstuffs independent of the railroad. The railroad, however, is an organization owning the rolling stock and tracks over which the cars are operated, while the motor-truck owner is often an independent unit, operating over a road controlled by the money of every road bond-buyer and taxpayer in his community, and the communities through which he must pass if he transports his product by motor truck to market.

Municipal Markets

It has been said that the cost of food has *not* been greatly lowered in eastern cities, where farmers, either single or co-operating, transport their products by truck from farm to market. This is true where the farmer sells to the wholesaler, and the wholesaler sells to the retailer who, in turn, sells to the customer, who is the ultimate consumer. By this method only the high freight and express rates of the railroad are eliminated, and these are replaced by the cost of motor transport.

But where municipal retail markets have been established, the cost of food products has been materially lowered. The farmer drives in with his produce and sells direct to the consumer. Many cities are developing these municipal markets, where those who cannot afford to pay the high prices charged by the retailer, and made necessary by the number

of hands through which the products pass, can purchase on the cash and carry plan.

The recent seizures of food products, under the war-time food laws, has turned the attention of the public toward cold-storage methods. The food hoarder is threatened with jail; the food controller or "packer" is being condemned, and drastic laws are being advocated to regulate monopoly and the withholding of products from the market by storing them.

Until production gets back to normal, and supply and demand are to some extent regulated by the completion of the reconstruction period through which we are now passing, we cannot hope for greatly lowered prices. But we can turn our minds to-day toward the construction of the necessary works which the present high prices and unstable conditions have made us realize played a big part in bringing about the situation which now confronts us. Governments, states and provinces have realized this, and we see evidence of their activity in the great, road-building plans now in operation or under consideration, the vast amount of money set aside for road construction purposes, and the active advocation of suitable legislation to bring about nation-wide systems of improved highways.

Proposed Federal Control

Conspicuous among the highway legislation now before the United States congress, is a bill pending in the senate which was introduced by Senator Townsend, chairman of the Committee on Post Offices and Post Roads. It is proposed in this measure to create a vast system of highways under federal control and maintenance. This system will embrace not less than 2%, or more than 5% of the mileage in actual use in each state.

What will such a system, when completed, mean to the people? For one thing which is fundamental—yet which has been long neglected and never properly considered—it will bring our food-producing areas nearer to our manufacturing centres. This means that the vast numbers of people engaged in manufacturing will, with proper legislation designed to bring about the condition, pay less for the food they eat and for everything that is produced by nature to feed the wheels of industry.

Saves Middleman's Profits

The man who lives on the highway and produces food products along the highway, will benefit by highway improvement chiefly because (if he transports his product direct to the consumer in the city via the municipal market or direct to the home), he will have the benefit of the profit now paid to the railroad company, the middleman, the cold storage plant and the retailer. In this way the farmer can get much more for his products than he receives at the present time and still sell them to the public at a lower price.

From this brief survey it is clear that the improvement of roads should be the concern of every person, whether he be laborer, farmer, merchant, banker, doctor, lawyer or otherwise, living either in the city or in the country.

The improvement of highways is a definite, fundamental step toward decreasing the high cost of living. It is something which needs no investigation to prove necessary. Let us put our shoulder to the wheel and roll the mud holes into better roads.

The Winnipeg Aqueduct Construction Co. has agreed to settle all claims against the Greater Winnipeg Water District upon the understanding that the district will pay $2,339 rebate on freight charges. Claims amounting to over $100,000 have thereby been dropped by the company.

The "Committee on Development" of the American Institute of Electrical Engineers has recommended that there be inaugurated the custom of periodically holding an engineering congress, the delegates to which should be selected from all parts of the United States under a plan to be devised for suitable representation, this congress to consider and take action on such matters of general interest to engineers and the public as may merit its attention and as have been previously advertised for a sufficient length of time to permit local organizations of engineers to consider them and to send instructed delegates.

SIGNIFICANCE OF CRACKS IN REINFORCED CONCRETE CONSTRUCTION*

By Stanley H. Harris

CRACKS frequently occur in reinforced concrete structures as in every other form of masonry construction. These cracks are generally due to one or more of the following five causes: (1) Cracking due to contraction of concrete in setting; (2) cracking due to expansion and contraction, caused by temperature changes in the concrete; (3) cracking due to too early removal of forms; (4) cracking due to overloading of the structure; (5) cracking due to settlement of supports.

When concrete sets in air it has a tendency to shrink or contract, and the richer in cement the concrete is, the greater the tendency to shrinkage and cracking. The shrinkage varies from 0.15% to 0.2% of the length for neat cement, and from 0.03% to 0.05% for concrete poor in cement. Although the strength of concrete increases with the amount of cement in it, too much cement, on the other hand, will cause frequent contraction cracks, which tend to neutralize any gain in tensile strength due to extra cement. This is a point which should be borne in mind when designing structures to hold water or other liquids. In these structures all the tensile stresses should be taken by the steel, and it is of the greatest importance to have a concrete which is dense and not liable to contraction cracking. A 1:2:4 concrete, made of properly-graded materials, will be sufficiently strong and dense for most tank work, and is likely to develop less contraction cracks than a richer mix.

Minor Temperature Cracks Unimportant

Cracking frequently occurs through expansion and contraction, due to temperature changes, especially in those parts of the structure which are exposed to the sun and weather, such as roofs and external walls. A great deal of this cracking can be minimized by the adequate provision of temperature steel, but within limits a certain number of minor temperature cracks are inevitable, and should be recognized as inevitable. They are unsightly, perhaps, but as a rule do not affect the strength of the structure.

Removal of forms too soon, produces cracks in floors and weak spots in walls. In the case of floors, if the forms are removed too soon slight settlement occurs, and the soffits of beams and the slabs develop fine hair cracks. In the case of walls there may be no visible sign of any injury, but they often divide at places in their thickness, which may be ascertained by tapping them with a piece of wood or metal, when the hollow sound produced is evidence of the result. Cracking due to this cause should never occur if the job is properly supervised.

Causes of Serious Cracks

Overloading of the structure or considerable settlement of supports produces the most serious cracks; in fact, they are usually the only kind of cracks of any considerable moment occurring in concrete structures. Cracks due to this cause usually occur as fractures in columns or as diagonal fractures in main or secondary beams. If such cracks occur, steps should be taken to remove the load and to strengthen the members affected. Sudden failure is not likely to occur immediately on the appearance of such cracks, as beams and columns generally will carry a lot more load after the first appearance of cracks, before final failure takes place. The appearance of these cracks, however, is often an indication that the member is overstrained.

In estimating the significance of cracks, some attention might profitably be given to what we might call "the eye of the observer." A mere hair crack in the eye of one observer is a chasm in the eye of his neighbor. It might truly be said that nature abhors an uncracked structure almost as much as she abhors a vacuum. No building has yet been devised by the mind of man and erected with his hands which does not have cracks, but their appearance in

*From the proceedings of the Royal Victorian Institute of Architects.

a reinforced concrete structure often arouses a quite unnatural malignity in the mind of some observers towards this long-suffering material. The philosophical reason for this would appear to be that a concrete surface invites the eye to hope for an unbroken plane, and then some untoward and unknown cause intervenes to produces a crack, and the eye and mind feel themselves tricked. All structures, even of the most monumental marble or masonry, have cracks equally with concrete; but, whereas reinforced concrete is monolithic and jointless in its character, all other constructions in masonry or marble are discontinuous and jointed. The result is this—that the cracks produced by movement in an ordinary jointed structure are dissipated, and spread over the innumerable beds and joints of the construction, but in a concrete structure they are apt, unless the steel reinforcement is sufficient and properly disposed, to concentrate themselves in well-defined and sometimes ugly openings. Very slight movements in the foundations of a reinforced concrete structure will often produce cracks which in appearance are out of all proportion to their significance. Such cracks, as a rule, do not affect in the slightest degree the stability of the structure, and are no greater in their totality than the numerous smaller cracks to be found in the joints of any brick or stone structure.

In a properly designed and constructed reinforced concrete structure there should never be serious cracks in the main structural members, and where there are no such cracks in these members, any cracks in the slabs supported by them are generally quite trivial, from the point of view of structural significance. Much worry would be saved by many architects and engineers if this were recognized and frankly accepted. Anyone promising to erect a large concrete structure which shall not have shrinkage and temperature cracks, merely engenders hopes which rarely come to flower. However, a great deal can be done to minimize these cracks in floor slabs by providing sufficient steel over the supports to resist the negative bending movements and by providing sufficient steel to counteract temperature and shrinkage effects.

An Australian Case

As an example of a large reinforced concrete structure containing big masses of concrete exposed to the sun and weather, we might mention the reinforced concrete dome over the Melbourne Library. At the time of its construction, in 1909, it was the biggest reinforced concrete dome in the world, the inscribed diameter being 115 ft., and the circumscribed diameter, 126 ft.

The detailed design of the reinforced-concrete dome over the Melbourne Library was prepared by the Trussed Concrete Steel Co., of England, to the requirements of the architects, Bates, Peebles & Smart, and the reinforcement, in the form of Kahn rib and Kahn trussed bars, was sent out from England all ready for fixing in the work.

In constructing the Melbourne dome, one complete rib on each side of the lantern ring was concreted in one day, together with part of the roof slab on each side of the dome ribs. The remainder of the roof slabs and purlins was filled in some days after the completion of the main ribs, as it was found impracticable to complete the concreting in one continuous operation. The result of this was that the concrete in the ribs had set fairly hard and contracted before the concrete in some of the roof slabs was poured, so that when this latter concrete set and contracted, it pulled away slightly from the flanges of the ribs in spite of steel placed in the flanges of the ribs and concreted into the roof slab with the idea of preventing it. Some years after completion of the dome the junction of the roof slab and flange of the dome rib was visible, showing in a distinct crack. The appearance of these cracks, running parallel with the reinforcement in the roof slab, does not affect the stability of the dome in the slightest degree.

The dome is octagonal in plan, and consists of eight angle ribs, and eight intermediate ribs restrained at the top by the lantern ring, and at the base by a continuous band of steel running around the top of the brick octagon which supports it. The dome is designed to be completely stable between the limits of the bottom ring of steel and the lantern ring, but for the sake of appearance, and also to add some extra stiffening to the ribs, they are continued past the bottom tension ring, across the flat annular roof, running around the dome in the form of deep concrete abutments. The abutments have an arched opening through them, and in each arch small cracks have developed, being most marked at the angle buttresses. These cracks are not as big as cracks often seen in brick railway arches carrying main-line traffic, and appear to be due to the combined effect of shrinkage and temperature both in the concrete and in the brick octagon underneath the dome, which is 114 ft. high to the springing of the dome. As the part of the dome in which these cracks appear is merely ornamental, they have no influence on the stability of the structure. In addition to these cracks, slight cracks have appeared in the ring around the base of the dome. The concrete ring, containing the continuous steel band, is a great mass of concrete having a cross-sectional area of about 20 sq. ft. From the nature of concrete it stands to reason that some cracking must occur in such a large ring, due to contraction and temperature effects. Since the thrusts from the rib are taken by the steel band contained in the concrete ring running around the base of the dome, the small amount of contraction and temperature cracking in the concrete ring cannot affect the stability of the dome as long as the adhesion of the concrete to the steel is not impaired.

A structure such as this, exposed to all the effects of wind, weather and temperature, must of necessity move or breathe under their action, and it would have been against the nature of things if no cracks had occurred.

Cracks Foreseen by Designers

At the corner ribs the thrust is transferred to the main tension ring by means of steel stirrups made of ¾-in. square steel-rib bars. It was at first thought that some of the cracking in the concrete work was due to these members not acting efficiently. It was therefore decided to construct a model of this part of the dome, one-sixth full size, and test it to destruction. The results of this test showed that not only did these members transmit the load efficiently, but actually strangled themselves in their efforts to transmit the loads. The stresses in the concrete and steel of the main members, taking into account temperature effects, were also investigated, and were found to be very low. The cracking, therefore, was found to be almost entirely due to the effects of contraction and variations of temperature, and that such cracking would occur was foreseen by the designers of the dome, and pointed out before construction was begin.

Where big concrete structures of this sort, exposed to the weather and temperature variations, are built, it is always advisable to place a false ceiling under the structure rather than plaster the ceiling directly on to the concrete work. Breathing movements must occur in such structures, and then the ceiling may crack and bits fall off, unless a false ceiling is provided.

United States Engineering Council has addressed a letter to the president of the United States urging that a board of surveys and maps be appointed, consisting of a representative from each of the present United States map-making agencies, together with representatives from well qualified map-using agencies, and that this board be invested with authority to devise a plan of standardization and co-ordination of the map work of the United States government and report same to the president for such action as he may find wise. Engineering Council states that at present the United States Geological Survey is the principle map-making agency of the United States government, but there are many other agencies of that government employed in similar work. Engineering Council states that a complete topographical map of the country would be very useful in the location of railways and highways; plans and location of drainage and water supply projects; prosecution of geological, soil and forest surveys; development of water powers; installation of electrical power lines; construction and maintenance of inland waterways; location of reservoir sites for flood prevention and water conservation; etc.

WATER DEPARTMENTS AND PRIVATE FIRE LINES*

Proper Regulations Governing Private Fire Protection Lines —Suggestions for Compensation—Contamination of Water Supply—References to Court Decisions

By Dow R. Gwinn
Terre Haute, Ind.

IN considering fire protection, there should be no confusion between that which is furnished by the municipality, known as public fire protection, and that which is for the exclusive use of all individual or manufacturing concerns. In the first case, the pipes and hydrants are on public streets, while in the second case large pipes are laid into private grounds and buildings to which are connected fire hydrants, automatic sprinklers, and stand pipes. The manufacturer who desires something more than the public fire protection should, of course, pay for private protection of a special character. A comparison could be made with the public police protection furnished by the municipality and that of a manufacturer paying for a private watchman or police. The municipality provides fire and police protection of a general character for the public. If special protection of a private character is desired, the cost is met by those who enjoy the special privileges. It is not necessary in every case to connect with the city water mains to enjoy private fire protection.

Protection by Independent Plants

This protection can be provided by means of independent or local equipment, such as fire pumps and elevated tanks. A number of manufacturing concerns now provide their own special fire protection in this way and in such cases they pay the actual cost of the same. This cost includes interest on the investment, depreciation, repairs, taxes, fuel used in maintaining steam, extra labor in looking after fire pumps, and also additional labor on Sundays, holidays and at such times as the factory may be shut down. It has been estimated by an insurance expert that the cost of such special private fire protection when furnished by the manufacturer would amount, in one particular case, to approximately $600 per annum.

Special Connections With Mains

This service is furnished in cases where the manufacturer does not wish to make the investment for fire pumps, etc., and to employ men to keep up steam on holidays, Sundays and such times as the factory may be shut down. Connections with public water supply should not be made with private pumping plants having other sources of supplies than that furnished to the general public. Typhoid fever epidemics have resulted in several cities on account of private fire lines being connected with the public water supply and also with contaminated sources through private fire lines. In the city of Lowell, Mass., I understand there were about 25 deaths; in Auburn, N.Y., there was a small epidemic; in Rockford, Ill., there were 40 deaths, although it is said that it was not clearly proven that the fire line connection was to blame. It is reported that typhoid fever epidemics have been caused by fire pumps draughting from polluted sources and seeping through leaky check valves into public mains at Sheboygan, Wis., and Morris, Ill. The public health is of such great importance and human life is so precious that no connections should be made between the public water supply by means of private fire lines and other sources of supply.

Where connections are made with a public water supply for private fire protection, there is a menace to the remainder of the city on account of danger of broken sprinkler pipes; there are a number of cases on record where the automatic sprinklers have failed to control the fire and falling walls have broken the large supply pipes, making it impossible for the water works to maintain adequate fire pressure. With a 6-inch supply pipe discharging a full stream, it would be practically impossible for the average water works plant furnishing water under direct pressure to supply adequate fire protection for a second fire in case one should break out at that time. The result of a broken sprinkler pipe might mean a serious conflagration and destruction of a large portion of the city.

It is the opinion of the author that insurance companies will realize this menace before many years have passed and will discourage if not prohibit large connections between the water mains and automatic sprinklers. At the present time, the Committee on Fire Protection of the National Board of Fire Underwriters recommend in congested valued districts, a supply of 7,500 gallons per minute in excess of the domestic consumption and state that this includes an allowance for loss from broken services, elevator, and sprinkler connections incidental to a large fire. This means that in order to provide fire protection which is considered adequate by the underwriters, it is necessary for the water department or company to provide equipment and mains sufficient to take care of a demand on account of broken sprinkler connections. This means an extra investment or cost to the water department or company. If such connections are furnished, the water department or company should receive just and reasonable compensation for such special service.

There should be no question in regard to the right to furnish this service by meter measurement and there should be no connections allowed unless the same are provided with meters. The meters for this purpose should, of course, be subject to the approval of the water department or company. In most cases, they should be meters which have been specially designed for fire lines, although there are cases where a compound meter would be satisfactory.

Suggestions for Compensation

(1) On the basis of the saved insurance premiums. These savings due to automatic sprinklers amount, in some cases, from $1,800 to $3,000 per annum. If the water department or company furnishes the service by which reductions in insurance rates are made, the compensation should be adequate. The reduction in insurance rates on account of automatic sprinklers in one particular case was from $1.60 per hundred to 20 cents.

(2) The compensation should be equal to the cost to the consumer if such special fire service was furnished independently. This will, of course, include interest on investment, repairs, taxes, fuel, extra labor, etc.

(3) Compensation to the water department or company on account of large mains, additional equipment, etc., necessary to provide adequate service to the manufacturer, and also for maintaining pressure and standing guard over premises of the manufacturer; under this arrangement, there should be a minimum meter rate on the basis of the size of the meter, in proportion to the minimum rates charged for ordinary house meters. Where the water department is standing by, maintaining pressure on the premises of the manufacturer, the compensation should be adequate for such unusual and valuable service.

Rules for Private Installations

1. All private fire protection services will be installed by the company, which will ascertain the best location for same, and lay the pipe from the street main to a point just inside the wall of the building, or within the building line of open yards, where buildings are set back from the building line. The consumer will be charged for time and material, plus 10 per cent.

Size of Service Pipe

2. In all cases, the company shall decide the size of the service pipe. In all cases where underwriters' pumps are to be installed, a suction pipe of sufficient internal area to deliver a quantity of water equal to the full rated capacity of the pipe will be allowed, and no enlargement of said suction pipe inside of the premises will be permitted. If, however, this service pipe is run to a surge tank placed in

*Excerpts from paper read before twelfth annual meeting of the Indiana Sanitary and Water Supply Association.

close proximity to the pump, the full size of suction which the pump calls for may be run from the pump to the tank.

3. One service only will be allowed to any one building or premises, unless in the opinion of the company, the general or public fire protection will not be jeopardized and more than one is absolutely necessary for the proper protection of the premises. All fire equipment connected to the company's service shall be confined within the building or on the premises named in the application, and where two or more connections are made for one building or premises, they shall be kept separated, unless special permission is obtained from the company to connect the same in a manner to be approved by it.

Test of Fire Services

4. Whenever a fire service system is to be tested under the regulations of the fire insurance underwriters, the consumer must notify the company of such proposed test, naming the day and hour when the same is intended to be made, so that, if desired, the company may have an inspector present during the test.

Contamination of Water Supply

5. Any fire protection system supplied with water from the company's service shall be supplied exclusively with such water, and no connection will be allowed with any other system drawing its supply from any other source whereby the company's water supply may be contaminated by the failure to close valves, or leaking check valves, etc., and no auxiliary or secondary suction pipe to any underwriters' pump taking water from wells, streams, or other source whatever, will be permitted. Any fire protection system using water from wells, streams, or other source than the company's service shall be kept separate from any such system supplied from the company's service.

Inspection

6. All fire services shall be subject to inspection by the company from time to time, and the consumer shall give the inspectors all reasonable facilities for making the inspections, and any information concerning the same that the inspector or the company may require. Care will always be taken that inspections will be made with as little inconvenience to the consumer or occupant as possible.

Approval of Fire Chief

7. All applications for private fire protection shall be subject to the written approval of the chief of the fire department of the city, who in such approval, shall state that, in his opinion, the public fire protection will not be endangered by the connection proposed to be made by the company, when properly safeguarded by the placing of an indicator post valve as near the main as possible, said valve to be under the control and orders of the chief of fire department at time of fires, with full authority to close said valve.

Guarantees

8. The company or department in no manner guarantees to furnish a proper quantity of water through fire protection services, nor does it undertake to guarantee anything relative to such service, but it will endeavor to maintain the efficiency of its service under all conditions. The granting of a permit for private fire protection is under the express condition that the company shall not be considered or deemed in any manner to have undertaken to extinguish fire or to protect any person or property against loss or damage by fire or otherwise, the said company not being an insurer of persons or property, and that it shall be free and exempt from any and all claims for damages on account of any injury to persons or property by reason of fire, water, failure to supply water or pressure, or for any other cause whatsoever, and that in the event of the destruction of the premises of the consumer, then the contract between the company and the consumer shall immediately cease.

Plans and Drawings

9. The consumer will furnish an accurate sketch showing the pipes, valves, hydrants, connections, and appurtenances on the premises of the consumer and connected with the mains of the company and also an accurate sketch of any other water pipe system and fixtures that may exist on the premises.

Excerpts from Court Decision

"The principal object of the defendant's water board in requiring fire service pipes to be metered is to prevent the surreptitious or careless withdrawal of water through such pipes for other purposes than the extinguishment of fires; another object is to procure the measurement by meter of all water consumed for any purpose in order to check wastage and to require each taker to pay for the exact quantity of water furnished to him. . . .

"Both upon principle and authority we are of opinion that under circumstances like those before us it is not unreasonable to require the installation of a meter at the plaintiff's own expense in its private fire service pipes.

"Nor can it be said that this regulation imposes undue burden upon the plaintiff. The defendant has afforded reasonable means of extinguishing fires by public hydrants; if the plaintiff desires in addition a private system for the protection of its own buildings, it is not unfair for the defendant to impose, as a condition of supplying without other charge water to make this system available, the requirement that the plaintiff shall take this water only through a meter to be put in at the plaintiff's expense." Shaw Stocking Company vs. City of Lowell. (Supreme Judicial Court of Massachusetts; Middlesex, May 2nd, 1908. 85 Northeastern Reporter, 90.)

Public Service Commission's Ruling

"These authorities are cited to show the views of courts of high authority, and for the further reason that they are in harmony with the conviction of all men who have thought seriously upon this subject. There is no perceptible reason why the water company should be compelled to provide and maintain a sufficient supply of water to operate the water sprinklers in time of fire for private individuals, without compensation. On the contrary, this special benefit to the property owner over and above what the municipal fire protection affords the people in common, should be paid by the private user." Indiana Public Service Commission in the case of Commercial Club of Terre Haute, vs. Terre Haute Water Works Company, decided December 18th, 1915.

"The proprietor of a building, who installed therein an automatic sprinkler system, intending thereby to put out fires before they could gain headway, derives benefit from the system in fire protection and reduced insurance rates, and though there be a general benefit in reducing fire hazards, yet a municipal water works system to which the sprinkler is attached performs a service, and stands ready to perform others for which charges may be made.

"It is evident that payment for the small quantity of water used would be wholly inadequate as compensation for the pressure required, and the readiness at all times to serve and the inspection by the city which might well be exacted." Edgerly vs. City of Ottumwa, 156 N. W. 388, decided February, 1916, by the Supreme Court of Iowa.

Action to restrain city from placing a meter on fire extinguishing plant dismissed by Appellate Division of the Supreme Court. Judgment affirmed with costs. American Manufacturing Co., Appellant vs. City of New York. Court of Appeals of N.Y., January 27th, 1911.

Entitled to Reasonable Compensation

"A water company which supplies the pressure and water for an automatic sprinkler for a private corporation performs a service which is not included under its contract with the city to supply water for fire protection and has the right to make a reasonable charge therefore against the corporation." D. B. Loveman Co. vs. City Water Co. 1 Tenn. Ch. App. 596.

"In the matter of furnishing water to its citizens, a city when authorized by its charter acts in a private rather than a governmental capacity and has the same right to make reasonable charges therefore that a private corpora-

tion has when serving the public." St. Louis Brewing Association vs. City of St. Louis, 140 Mo. 419—37 S. W. 525. 41 S. W. 911.

"A rule providing that water meters might be installed at the pleasure of the water board on the consumer and that after they had once been installed, the consumer could not thereafter return to the flat rate is reasonable and may be enforced where the meter rates are reasonable and no discrimination between consumers is shown." Powell vs. Duluth. 97 N. W. 450.

"The law imposes no duty to insure the property or extinguish fires." Woodberry vs. Tampa Water Co. 57 Fla. 243, 49, So. 556.

The Arizona Commission in fixing rates to be paid to a water company, decided that a mining company desiring a private fire protection system, should be required to pay a fixed demand charge although "the actual water consumed for this purpose is likely to be negligible." Arizona Corp. Com. vs. Morenci Water Co., Public Utilities Reports, 1915, C. 525, 527.

SOME LESSONS AND PROBLEMS*

By F. W. Bricknell
City Engineer, Hull, Eng.

IT may be useful to consider in what way and to what extent the war has left its mark on municipal work.

All the usual services have, of course, been badly hit by the scarcity of labor and material, so much so that, locally at any rate, prices have hardly needed to be considered.

Taking these services in detail, highway maintenance has probably called for the most criticism from the general public. Here the necessity for deferring repairs far beyond ordinary practice has given an opportunity for verifying pre-war opinions.

There was nothing left to learn about granite-sett paving, and scarcely any repairs have been necessary during the war.

Paving Experiences

In regard to wood paving, there has been more cause than ever to regret the extensive adoption of Australian wood, and it could almost be said that the paving with Petrograd redwood has caused no anxiety at all, and will require comparatively little attention before the Australian wood is replaced. About 160 standards of Petrograd deal, purchased in 1915, served for urgent replacements until the middle of 1918, and since that time English oak and larch have been used; but, wherever possible, the old blocks have been turned and relaid on a "soft bed." English larch offers considerable promise as a paving wood. It takes creosote unevenly, and some has been laid without creosoting, but that now in use is being creosoted by the Rueping process. The oak used is, of course, not from long planks, but from "offcuts" and billets.

The Trinidad asphalt paving, referred to in the writer's 1916 paper, has given general satisfaction, and this paving, now known as "Lithocrete," has been selected for the streets to be paved under the "Road and Bridge Program, 1919-20." There were special and local reasons for preferring this paving to the less expensive two-coat work.

Many macadam roads have become less comfortable for cyclists, but none have caused serious complaints. The situation has, in fact, been saved by tar-spraying, and the writer sees no reason to change the opinion he expressed in 1916 that, except where heavy rubber-tired traffic has to be carried, water-bound whinstone macadam, tar-sprayed annually, is far preferable to tar-macadam.

Welding Tramway Rails

The tramways have fully justified the ideas of their designer, the late Mr. White; but rails which have been eighteen to twenty years under traffic are naturally showing wear at the joints. Up to 1916 it had been the practice to pack up a hammered joint until the lowest part was at normal level and then to dress off the projecting portion. This would, of course, eventually have destroyed the rail head, and in 1916 acetylene welding was adopted. In 1918 acetylene supplies were so difficult to obtain that an arc welding set was purchased, and although this involves night work, it seems likely to supersede acetylene, as, so far as can be judged at present, the results are more permanent.

The value of the close anchorage of the rails is very plainly seen now that some of the holding-down bolts have given way. At such places a pumping action is set up with more or less subsidence of the rail.

Of new developments during the war it is only necessary to mention food production and national kitchens.

Allotments and War Gardens

While every possible effort was made to obtain additional allotments, it was necessary to accommodate about 1,850 applicants on war plots. With one or two unimportant exceptions the owners of the land gave every encouragement, and no rent was paid by the corporation except for land already earning rent. For the most part the plots were let off in batches to a "principal tenant," who paid an acknowledgment of one shilling. In most cases the tenants did all their own work, but in some cases fencing, drainage, etc., was done and an additional rent charged.

The difficulty with regard to allotments proper was that all suitable land was regarded as ripe for building, and the owners would not tie it up for a period of years. It was found, however, that tenants were quite willing to take the risk of disturbance for building, and a number of leases were entered into for periods up to ten years, with a provision that the owner may resume possession at short notice for *bona-fide* building development without payment of compensation. After a time an officious person discovered that tenants could not contract out of the Act, and since that time no further land has been taken. The total area leased during the war was about 170 acres, let off to about 2,176 tenants. The rent paid by the corporation varies from £2 10s. to £5 per acre, and after paying for fencing, drainage, road-making and water supply, it is necesary to charge rents varying from 10s. to 12s. 6d. for a plot of $\frac{1}{16}$ acre.

Every possible assistance has been given to occupiers in the way of free literature, lectures and advice, the supply of manures and lime at wholesale prices, and the spraying of potatoes at less than cost.

National Kitchens

While it is to be hoped that no lesson is required for the future, it is probable that existing national kitchens have a long life before them, and there is no doubt that in many districts their catering offers a welcome relief from the intolerably bad private catering.

The principal point of interest about the Hull kitchens is the policy which was pursued of taking over existing shops which were finding a difficulty in obtaining supplies and installing the tenants as managers. Generally speaking the arrangement has been a great success, one branch in particular yielding very large profits. The policy fell short of obtaining the best results because, on the one hand, it was not fully developed before the need was past, and not enough branches were opened to keep the central kitchen fully occupned; on the other hand, the branches needed a supply of confectionery and sundries to keep them occupied for the full day, and it was only after considerable delay that a bakery was rented and set to work for this purpose. The committee has, however, every reason to congratulate itself on the success of its policy, and it is all to the good that when times become normal their managers will be able to resume their old businesses with improved premises, wider custom, and some useful lessons.

Turning to the future, there are three sets of problems which are exercising the minds of most municipal engineers. The most conspicuous of these is, of course, housing, as to which the writer does not feel himself in a position to speak, as his connection with it is confined to the construction of streets and sewers. Here it is necessary to face those problems of routine work which are concerned with giving the ratepayer satisfactory services at not too great an increase

*Paper read before the Institution of Municipal and County Engineers, July 26th, 1919, in Hull, England.

on the old prices, and the means of doing so will be discussed later. Meanwhile, the writer would emphasize the importance of making each scheme part of a town-planning scheme, and avoiding the isolation which has been the bane of private estate work in the past.

Next, and probably the most attractive subject, is the flood of new works which has been held up by the war, all of which works have earnest advocates, each of whom is anxious that his pet scheme shall have preference over all others. If a small proportion of the Hull schemes materialize the writer will have an interesting time, and there will be good material for another visit of the institution. It remains to be seen how far the financial condition of the country will allow the schemes to materialize.

Use of Machinery

The third problem, and that to which I wish to direct the special attention of members, is that of bringing the cost of routine work and also that of street and sewer construction to such a figure as can be covered by a not intolerable increase of the rates. With average weekly wages doubled, cost of materials more than doubled, and assessments stationary, it is difficult to see how the doubling of rates can be avoided, and it might be said that the ratepayer has no right to expect it, but he is at any rate entitled to an effort.

The first cost to be attacked is that of labor. The old class of navvy and horseman, who was recruited from the country, has almost disappeared from the towns, and most of those who are in the towns can find easier and better-paid employment than that offered by a municipal body. The townsman has an inferior capacity for heavy work and a very strong prejudice against it. The obvious policy, therefore, is by some means to cut out the heavy work and endevor to staff public works with men who will use their heads. A simple example is the use of scarifiers to break up macadam roads. Formerly these were not used in Hull because they would displace labor. Now they have to be used, because pick-work is unpopular. If all increase of costs could be met as easily as this there would be no scope for a discussion.

Problems in Mechanical Loading

In view of the urgency of housing work and the shortage of navvies, the writer has looked into the question of using trenching machines for the sewer and gas, etc., trenches in the new streets. At the time of writing the economy of such a machine for the amount of work required at Hull is doubtful. One cannot propertly adopt the usual practice of debiting the work with a percentage for interest and depreciation, but must charge the whole cost of the machine to the rush of work for which it is purchased. Before this paper is read no doubt some additional light will be thrown by Mr. Collins' paper at the general meeting.

A much simpler proposition is a tamping machine. The first cost is comparatively small, and not only should there be a saving in working expenses, but there should be an efficiency which was lamentably wanting in hand-work.

The loading of vehicles is work which cries out loudly for mechanical assistance. Costly vehicles are kept standing when they might be running, and good horsemen and motormen are lost because, being good, they can obtain work in connection with mills, etc., where they do not have to handle their loads. The writer has been able to obtain the use of high-level coal cells, and to obtain delivery of a certain amount of road metal and fuel in hopper wagons, which is an admirable solution so far as it goes. Some material landed at wharves by crane can be taken direct to its destination, but there remains a great deal which has to be picked up in the yard and elsewhere. There are some inexpensive mechanical loaders which deal well with dry macadam, gravel, etc.; but tarred material is a problem, and destructor clinker is even more unpopular with the man, and there is more of it. The average cost per ton is probably four times what it was ten years ago.

Improved Road Surfaces

In street cleansing most engineers, no doubt, find that they are already reaping the benefit of past work in improving road surfaces and in tar-spraying. Where a reasonably hard stone has been used, even an untreated water-bound macadam road which has been repaired several times by steam rolling, has a much lower dirt-producing capacity than the old roads of the writer's early days. The partial disappearance of the horse has effected some relief, and for about fifty weeks in the year the only scope for economy seems to lie in substituting single-handed work for gang work in all but the principal streets. During the dirty weather in late winter good use can be made of a picking-up machine, but it must be an inexpensive machine which can be attached to another vehicle. The writer has used Whittome's machine with satisfaction for some years.

Most engineers probably have to continue to use the motive power already at their disposal. In a fairly level town, and for miscellaneous work, there is not a great deal to choose between various types, and the capital cost of mechanical vehicles is a deterrent to their use at the present time. Given plenty of heavy work and suitable loading facilities, steam is by far the most economical. During the war, when the writer was hard pressed for both horse and mechanical drivers, an electric rully was ordered with the idea of employing a man of the navvy type to drive it. A permit was obtained after the armistice, but at the time of writing the rully is not delivered.

Economies in Material

The writer would like to elicit opinions as to economies in material. Most towns have their particular extravagances and parsimonies. In Hull natural flags have benerally been used. There seems to be no justification for continuing to buy them when highly satisfactory artificial flags can be laid at half the price. Wood-paving blocks, where large areas have to be relaid, might be reduced in depth to 3 ins. There are purposes for which concrete can replace other materials, but with cement at the present price the number of purposes is reduced.

The cost of refuse destruction has for long been somewhat of a bugbear to the writer. During the war not only has the cost of wages more than doubled, but the character of the refuse has changed, its calorific value having become almost *nil*, and the so-called clinker increased to about 50 per cent. of the original weight.

In the interest of allotment-holders the corporation was allowed to establish an experimental pulverizing plant which had been held over from the outbreak of war. It is too early to give financial results, but it is safe to say that the cost of treatment is less than burning, and there is no clinker problem; but the small plant dealing with about one-fifth of the refuse easily supplies the present demand for the manure. Such a plant really should be a destructor, as a great deal of large stuff has to be thrown out, especially during "spring cleaning," and has to be destroyed by other means.

If the demand for the manure increases the writer proposes to install a screen at one of the destructors and screen out the small stuff for manure, in the expectation that he will thus get rid of a great deal of the inert matter and obtain better furnace results from the remainder. Meanwhile, he is encouraging the health department, who collect the refuse, to dispose of as much as possible by tipping, and he has no hesitation in defending the practice.

Established Services Severely Treated

It is not to be hoped that any alterations of practice will bring expenditure appreciably nearer its old level, but it is a usual experience that councils handle the estimates for established services much more severely than those for new schemes and new departments. In the hope that the exchange of ideas will enable members to maintain the efficiency of their works in spite of this tendency, the writer has put together his notes with the feeling that their value depends on the extent to which they elicit the ideas of othe

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Approximately 1,200 houses have been built this year or are now being erected in Ontario under the provisions of the Act granting loans to home-builders. In Ottawa, 120 houses, valued at more than $400,000, are under construction; in Oshawa, 34 houses; in Windsor, 65 houses; and similar renewed activity is being indicated in many other cities.

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TORONTO'S SEWAGE DISPOSAL PROBLEM

IN the article on performance of the slow-sand filters at Toronto, which appeared last week in *The Canadian Engineer*, Norman J. Howard, bacteriologist in charge of the filtration plant laboratory, shows that the pollution of Toronto's raw-water supply has increased approximately 62% within the past five years, judging by B. coli tests. Of the 300 days in which examination of the raw water was made during the year 1918, the typical colon-bacillus was present in one cubic centimetre on 121 days.

The continual deterioration of the raw water at Toronto is due to the increase in discharge of sewage into the lake. While this applies not only to Toronto but also to many other neighboring municipalities which are daily discharging large quantities of sewage into the lake, the absence of proper sewage disposal works at Toronto is undoubtedly responsible in a very large degree for the increased pollution. The Morley Avenue sewage disposal plant, which has never operated to the satisfaction of either the municipal authorities or the public, is now reaching the limit of its capacity for even such work as it is doing, and it is said that within a few months it will have exhausted the areas at its disposal for the deposit of sludge.

As the late Theodore Roosevelt remarked several years ago in Buffalo, the people of Canada and the United States should be sufficiently civilized to be able to get rid of their sewage in some other manner than by dumping it into their drinking water.

Toronto, like many other cities, is faced with a sewage disposal problem that may cost a large sum of money before a satisfactory solution is found, but it will be money well spent, for no money can be spent to better advantage than in the improvement of public health, and there is no phase of sanitary work that is of more importance than the protection of water supplies.

Fortunately for Toronto and many other cities, the liquid chlorine plant which was installed a few years ago has proven extremely efficient. That chlorinating plant is the only thing that stands between Toronto and a great increase in the typhoid death rate. The amount of raw sewage that is being poured into the lake, comparatively near the water supply intake, is so polluted with matter of excremental origin that the water could never be filtered so efficiently as to render it entirely innocuous. Moreover, the filtration of such heavily polluted water would cost an enormous sum for coagulant if Toronto's drifting sand filter plant had to be operated every day in the year, and every hour in the day, to the highest possible efficiency. In order to reduce the expense for coagulant, the plant is now being operated, it is said, at a lower efficiency than the filters are capable of showing, and the chlorinating apparatus is being relied upon to sterilize the water, as it has been proven by months of experience that the chlorine treatment ensures sterile water even when the filters are being used only to cleanse the water.

The high efficiency of the chlorine plant, however, does not excuse Toronto from a solution of the sewage disposal problem. It is far safer to prevent pollution of water supplies than to remedy the pollution. There will come a day when the load upon the Toronto filtration and sterilizing plants will be extremely serious unless active measures are taken to solve the sewage disposal problem. The works department of the city of Toronto realizes this, as the works commissioner has been requesting the city council for the past two or three years to authorize the expenditure of $50,000 for sewage disposal experiments, but some of the other civic officials and some of the city councillors have not so thoroughly realized the urgent need for action. Nevertheless it is understood that the department intends at an early date to send an engineer to Milwaukee to reside there for several months in order to study the activated sludge method of sewage disposal in co-operation with T. Chalkley Hatton as consulting engineer; and also that the department intends to experiment with a new English centrifuge for dewatering sewage sludge. It has also been said that Dr. Nasmith, director of laboratories of the health department of Toronto, has under investigation a very promising method of sludge disposal, and his work is being watched with interest by the other Toronto civic officials.

WATER WORKS MONTHLY REPORTS

AS a part of its system of control of water purification plants in Wisconsin, the Board of Health of that state recently issued a report form which must be filled out and returned monthly by the superintendent or operator of every water purification system within the board's jurisdiction.

The form requires a statement of the number of gallons of water pumped, pounds of liquid chlorine or "hypo" used per twenty-four hours, P.P.M. of chlorine used, free chlorine in treated water, bacteria count in raw and treated water at 20 and 37 deg. C., and the B. coil count in raw and treated water in 1cc. and 10cc. This information must be given for every day of the month; also the number of filters used each day, the hours of service of each filter (length of run), the average filtration rate, the loss of head (initial and final) on each filter, the number of washes and number of minutes per wash, the amount of water used for washing, the amount of alum used in pounds and in grains per gallon, the turbidity in P.P.M. in the raw water and in the effluent of each filter, and the alkalinities of the raw and clear water.

If the board can persuade all plants, both large and small, to make a complete return of this information for every day in the year, it will certainly have a valuable record of water supply conditions in that state, but we fear that in connection with the reports from small plants there will be either many blanks or frequent guesses. However, it is the intention of the board to conduct an efficiency run of every plant at least once a year, and that will assist greatly in checking the reports.

Sept. 25, 1919

PERSONALS

DR. GEORGE G. NASMITH, who will be one of the three partners in the newly-formed consulting firm, Gore, Nasmith & Storrie, Toronto, was born December 31st, 1877, in Toronto, Ont. He attended the Wellesley public school and in 1896 graduated from the "Old Grammar School," now the Jarvis Collegiate Institute, and enrolled at the University of Toronto in the natural science course, specializing in geology, chemistry and mineralogy. From 1900 to 1902, he took a post-graduate course in science and physiological chemistry, obtaining the Ph. D. and M.A. degrees. In 1902, Dr. Nasmith joined the Ontario Board of Health as a chemist under Dr. Amyot, and during the following eight years wrote a number of papers on chemical research, including several articles on coal-gas poisoning and water sterilization. A paper upon the latter subject was published in the Royal Army Medical Journal and the method described was later adopted in many places throughout the world. In 1910, Dr. Nasmith became director of laboratories for the health department of the city of Toronto, from which position he is now resigning, the resignation to take effect at the end of the current year. Dr. Nasmith recommended chlorination of the water supply of the city of Toronto at the time of the break in the intake in 1911, and lowered the typhoid death rate from 42 to 20 per 100,000 (which figure has since been reduced to the present rate of approximately 2 per 100,000). It is largely to Dr. Nasmith that credit is due for the elimination of excess water from Toronto's milk supply, saving about $600,000 during the past few years for the people of Toronto. He is the inventor of the brush trickling filter for sewage disposal plants, and is now working upon a solution of the sewage sludge problem. In 1914 Dr. Nasmith went to Valcartier as head of the Hydrological Corps, in charge of water supply, and was requested by Gen. Sir Sam Hughes to go overseas as sanitary adviser to the first Canadian expeditionary force. Dr. Nasmith originated the portable filtration and sterilization unit which was adopted by the British War Office, and was sent to France with the rank of colonel, in charge of the Canadian Mobile Laboratories attached to the First British Army. At the second battle of Ypres he discovered that the gas being used by the enemy was chlorine. He promptly found an antidote and devised a gas mask. For these and other services, on New Year's Day, 1916, he was invested with the Companionship of St. Michael and St. George. Upon his return to Canada, he received the honorary degree of D. Sc. in 1917, and last year he passed the examinations at the University of Toronto for the degree of D.P.H. (Doctor of Public Health).

LT.-COL. A. E. DUBUC, D.S.O., has been appointed by the Department of Railways and Canals, Ottawa, as superintending engineer for the Province of Quebec, to succeed the late Ernest Marceau.

PAUL E. MERCIER, consulting engineer to the city of Montreal, has resigned. Mr. Mercier was appointed deputy chief engineer of the city of Montreal in 1914, and in January, 1916, chief engineer. In May, 1918, he became director of public works, from which position he retired last November to act as consulting engineer to the civic departments.

WILFRED HOLLINGWORTH, of the contracting firm of Brennan & Hollingworth, Hamilton, Ont., has sold his interests in that firm to his partner, W. C. Brennan, and has returned to England. Mr. Hollingworth came to Canada from England several years ago, and for a time was assistant city engineer of Hamilton.

MAJ. L. E. SILCOX is now on the engineering staff of the C.N.R., locating the line west of Bengough, Sask. In 1914 Major Silcox was locating engineer of the Hudson Bay Railway. He and twelve men who were working with him enlisted for overseas service. Seven of them won decorations for gallantry, Major Silcox being awarded the D.S.O., and one was killed.

L. N. EDWARDS, who resigned a few months ago as supervising engineer of bridges, Department of Works, Toronto, in order to accept a position as senior highway bridge engineer with the Bureau of Public Roads, Washington, D.C., has been transferred to Fort Worth, Texas, and will be district engineer in charge of the bureau's bridge work in Mississippi, Arkansas, Oklahoma and Texas.

ELMER LUNDERVILLE, comptroller of the Canadian Ingersoll-Rand Co., Ltd., Sherbrooke, Que., has resigned and has purchased the munition-manufacturing plant of the Norwood Engineering Co. at Cowansville, Que., where he will make a number of engineering specialties after he has equipped the plant with some new machinery. Mr. Lunderville joined the Ingersoll-Rand sales staff about twelve years ago, and was subsequently the firm's purchasing agent for several years.

W. F. V. ATKINSON, chief forester of the Spanish River Pulp & Paper Mills, Ltd., is entering private practice at Sault Ste. Marie, Ont. He will continue his connection with the Spanish River Pulp & Paper Mills, Ltd., in a consulting capacity, and intends also to conduct investigations of natural resources for any other companies who may desire his services in establishing new industries dealing with timber lands and water powers. He will specialize in forest engineering, including water storage and conservation.

TOWN PLANNING INSTITUTE OF CANADA

WITH the co-operation of the Commission of Conservation of Canada, a joint meeting of the American City Planning Institute and the Town Planning Institute of Canada will be held October 17th and 18th at the Chateau Laurier, Ottawa.

The secretary of the congress is Flavel Shurtleff, 19 Congress St., Boston. The assistant secretaries are M. J. Patton, 30 Rideau St., Ottawa; and F. D. Henderson, Topographical Surveys, Ottawa.

The congress will be opened at 2 p.m., October 17th, by addresses of welcome by Hon. N. W. Rowell and Mayor Fisher, of Ottawa. These addresses will be followed by a report of the committee on the fundamental principles of city planning (Frederick Law Olmsted, chairman); a report of the committee on street widths (B. A. Haldeman, chairman); and discussion. After an informal dinner the report of the committee on zoning (Mr. Bassett, chairman) will be presented, followed by discussion.

At. 9.30 a.m., Saturday, October 18th, Morris Knowles will present the report of his committee on the economic design of utilities in streets, and Arthur B. Comey of the committee on lot sub-division. At noon the delegates will be the guests of the Canadian Club at luncheon. The speaker will be C. H. Mitchell, dean of the Faculty of Engineering, University of Toronto, whose subject will be "Reconstruction and Town Planning." In the afternoon the town planners will visit the Parliament Buildings and drive around the city and parks. In the evening Thomas Adams, chairman of the Town Planning Institute of Canada, will present a paper on "Practical Housing," illustrated by moving pictures; and Noulan Cauchon, chairman of the Ottawa branch of the Town Planning Institute of Canada, will read a paper on "The Planning of Ottawa."

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand or proposed, contracts awarded, changes in staffs, etc.

TENDERS PENDING

Further information may be had from the issues of *The Canadian Engineer*, to which reference is made.

PLACE OF WORK	TENDERS CLOSE	ISSUE OF	PAGE
Alvinston, Ont., roadwork	Sept. 27.	Sept. 18.	45
Alvinston, Ont., drains	Sept. 27.	Sept. 18.	46
Manyberries, Alta., school	Sept. 27.	Sept. 18.	50
Notre-Dame des Sept Douleurs, Que., whrf	Oct. 2.	Sept. 18.	52
Orillia, Ont., hospital	Sept. 26.	Sept. 18.	50
Peterborough, Ont., Bobcaygeon Section, Trent Canal	Sept. 29.	Sept. 11.	44
St. Laurent, Orleans, Que., wharf	Oct. 2.	Sept. 18.	52
Unity, Sask., combustion engine, power station, etc.	Oct. 15.	Sept. 18.	54
Windsor, Ont., bank		Sept. 18.	50

BRIDGES, ROADS AND STREETS

Anderdon Tp., Ont.—Tenders addressed to A. C. Mailloux, township clerk, Amherstburg, Ont., will be received up to 4 p.m., Saturday, September 27th, 1919, for the supply of all materials and the erection of one abutment and two wing walls for the bridge over the Canard River, and placing the said bridge on a level with the highway. Plans and specifications may be seen at J. J. Newman's office, in Windsor, and at the office of the township clerk.

Belleville, Ont.—City council contemplates construction of pavement on Pinnacle St.

Belleville, Ont.—Council contemplates construction of an asphaltic pavement on West Bridge St. from James St. to Octavia St. Estimated cost, $11,000. Granolithic sidewalk on west side of Ann St., estimated cost, $1,582.68. J. G. Mill, city engineer.

Bengough, Man.—Tenders will be received until 12 o'clock noon, October 6th, by the C.N. Ry., for grading and culverts on the Maryfield branch, from Bengough, westerly 17 miles. H. A. Dixon, chief engineer, Winnipeg.

Brantford, Ont.—The Brantford chamber of commerce is taking the initiative in protesting against the type of road to be laid on the provincial highway, and will request all municipalities from Hamilton to Windsor, or near the highway, to co-operate in opposing the laying of a bituminous macadam road. The request for co-operation in the matter will be sent to the municipalities to urge the government to build the road of concrete as originally intended.

Chatham, Ont.—Tenders will be received until September 27th, by W. M. Abraham, R.R. No. 1, Chatham, for construction of 5,000 sq. ft. of sidewalks at Louisville, township of Chatham. Plans, etc., at office of W. G. McGeorge, engineer, Chatham.

Edmonton, Alta.—City council proposes to construct plank sidewalks on 93rd, 95th, 103rd, 114th, 115th and 116th Streets, and on 103rd, 103A and 104th Avenues. C. E. Cox, city clerk.

Enniskillen Tp., Ont.—Tenders will be received by Angus Stonehouse and Andrew Elliott, Commissioners, up to 6 p.m. on Wednesday, October 15th, 1919, for the repair of the McCrae drain. Plans and specifications may be seen at the office of Geo. V. Wyast, Petrolea, township clerk.

Ferguson Falls, Ont.—The new steel-concrete bridge over the Mississippi river has been completed and is now open for traffic. Bridge is 260 ft. long with five concrete piers and approaches. Superstructure is of steel with concrete roadway. Cost of steelwork, $14,000; total cost, including partial removal of old wooden structure, $20,612.60.

Fort William, Ont.—Contract has been awarded to the National Paving Co. for construction of pavement on Vickers St. at the C.N. Ry. station. Contract price, $4.65 per sq. yd. Curbing to Peter Bell, contract price, $1.70 per lin. ft.

Galt, Ont.—City council proposes to construct asphaltic concrete pavement on Queen St. W., from West Main St. to Blair Rd., and a bituminous macadam pavement westward from the railway tracks to Blair Rd.

Hamilton, Ont.—County council granted permission to the village of Freelton for construction of sidewalk on east side of Brock Rd. to the 9th concession.

Hamilton, Ont.—The property committee has recommended to the board of control that work proceed immediately on construction of concrete platforms and roads required for the new market shelters. Estimated cost of concrete work, $10,000.

Hartney, Man.—Tenders will be received until 10 a.m., October 17th, by the council of Cameron municipality for construction of a wooden pile bridge across the Souris river, between sections 6 and 7 in 6-23. T. B. Woodhull, secretary-treasurer.

Hatley, Que.—Tenders will be received by the council of the village of Hatley, until 1 p.m., October 3rd, for construction of roadbed and concrete bridge at Woodman brook on the Massawippi Rd. H. B. Whitcomb, secretary-treasurer.

Montreal, Que.—The Automobile Club of Canada in co-operation with local boards of trade will urge the Dominion government to complete construction of the Laprairie dyke and roadway.

Mt. Lehman, B.C.—Council will undertake temporary repairs to the main roads this fall. R. Owens, Matsqui.

New Glasgow, N.S.—Ratepayers have authorized issue of bonds providing for extension of Archimedes St., $6,800; pavement on Glasgow St., between Victoria St. and Imperial Oil, Ltd., $4,500; sidewalks on Forbes St., s.s.; McLean St., both sides; Albert St., both sides; East River Rd., e.s.; Washington St., w.s.; Abercrombie Rd., both sides; Willow Ave., s.s.; Maple Ave., both sides; North Provost St., e.s. Estimated cost of sidewalks, $17,000.

Newmarket, Ont.—Contract has been awarded by town council, to Sheardown & Bone, for construction of concrete bridge opposite lot No. 7, concession 4. Contract price, $3,200.

Oil Springs, Ont.—Tenders will be received by D. P. Sisk, village clerk, Oil Springs, up till 8 p.m. on Tuesday, September 30th, 1919, for the construction of a granolithic sidewalk. For particulars apply to Ellwood Mott.

Orillia, Ont.—Contract has been awarded by the county council to Curran and Clement, for construction of a 20 ft. concrete pavement on the Atherley Rd. Contract price, $1.10 per sq. yd., cement to be provided by county. County engineer Campbell.

Orillia, Ont.—Contract has been awarded by the G.T. Ry. for construction of bitulithic pavements in the station yard to the Warren Bituminous Paving Co., Toronto.

Ottawa, Ont.—At a recent meeting the Carleton County Council gave the first reading to a by-law calling for the raising of $75,000 for a new 400-foot bridge across the Mississippi River, about two miles from Galetta, in Fitzroy township.

Preston, Ont.—Preston Parks Commission will construct a two-mile automobile drive and bridal path in Speed Park. Other improvements include tearing down of the old hockey rink and erection of a soldiers' memorial gate. Total estimated cost, $25,000.

Regina, Sask.—The Crown Paving Co., who recently secured the contract to resurface Dewdney St., east of Albert St., have commenced work. Contract price, $21,000.

Scarboro Township, Ont.—Township council contemplate opening the government road running from stop 22, Kingston, to the side line between lot Nos. 26 and 27.

Spencerville, Ont.—Construction of roadbed on the Ottawa-Prescott highway, between Kemptville and Prescott, has commenced. It is expected that the abutments for the new highway bridge over the Nation river will be completed this year.

St. John, N.B.—G. N. Hatfield, city engineer, is preparing a program of street paving to cover a period of 4 years. Estimated cost, $1,000,000.

Toronto, Ont.—City council has passed a by-law providing for pavements on sections of St. Clair Ave.

Toronto, Ont.—The Toronto civic guild has prepared a plan for a proposed widening of Bloor St., east of Yonge St. to Sherbourne St.

Toronto, Ont.—The work of raising the grade on Weston St., at Mount Pleasant Rd. has been completed for 400 yds. along the north side, and has been started for the same distance on the other side.

Toronto, Ont.—Plans are being considered by the provincial secretary and property commissioner Chisholm, city of Toronto, construction of a road through the jail grounds at Gerrard St. and Broadview Ave.

TENDERS FOR SUPPLIES

Tenders will be received by registered post only, addressed to the Chairman, Board of Control, City Hall, Toronto, up to 12 o'clock noon on Tuesday, October 14th, 1919, for the supply and delivery of:—

Tender No. 41—Trainmen's Uniform Overcoats.
Tender No. 49—Revolving Cantilever Crane.
Tender No. 50—Canopies for Subways.
Tender No. 52—Two Motor Trucks.
Tender No. 53—Concrete Mixer.

Envelopes containing tenders must be plainly marked on the outside as to contents. Specifications and forms of tender may be obtained at the Works Department, Room 12, City Hall. Tenderers must comply strictly with conditions of city by-law as to deposits and sureties, as set out in specifications and forms of tender. The lowest or any tender not necessarily accepted.

T. L. CHURCH (Mayor),
Chairman, Board of Control.
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TENDERS WANTED

County of Huron, Ont.

Tenders will be received until October 11th, 1919, for the construction of the Kirk and J. B. Young Drains in the Township of West Wawanosh, County of Huron, Ontario. Kirk Drain 11,830 cu. yds. open work, 845 cu. yds. covered work. J. B. Young Drain, 15,300 cu. yds. open work, 272 cu. yds. covered work.

Plans may be seen at the office of John Roger Mitchell or at the office of the Township Clerk, Lucknow.

A marked check for 10 per cent. of tender must accompany each tender. The lowest or any tender not necessarily accepted.

W. A. WILSON, Clerk,
357 Lucknow P.O., Huron County, Ont.

Toronto, Ont.—City council will consider plans for extension and widening of Leader Lane, University Ave., south to Union Station, widening of York St., and construction of a new street between York and Bay Sts., southerly to Front St.

Toronto, Ont.—Plans have been prepared by the Railway and Bridge Section of the Toronto Works Department for a wooden trestle on St. Clair Ave. East. Tenders will soon be called for the construction of this trestle with the idea of extending the St. Clair Ave. civic car line eastward across Yonge St., thence northward through the Mount Pleasant Cemetery grounds and along Mount Pleasant Rd. to the city limits.

Toronto, Ont.—Tenders will be received up to noon, September 30th, for the construction of the following works: Asphalt Pavements—Annette St., from Keele St. to High Park Ave.; Annette St., from High Park Ave. to Fairview Ave. (except the intersections of Quebec, Clendenan and Evelyn Aves.); Fernwood Park Ave., from Fir Ave. to Hazel Ave.; Fernwood Park Ave., n.s. Fir Ave. to 306 ft. south; Front St., from John St. to w.s.l. Spadina Ave.; McLean Ave., from Queen St. to south end; Middleton St., from Sheridan Ave. to Brock Ave.; Kenilworth Ave., from Queen St. to 200 ft. north; Kenilworth Ave., from 200 ft. n. of Queen St. to 1,228 ft. s. Kingston Rd.; Logan Ave., from G.T.R. tracks to Gerrard St. Bitulithic Pavements—Northcliffe Blvd., from Regal Rd. to St. Clair Ave. (except intersection Lauder Ave.); Rosemount Ave., from Glenholme Aye. to Northcliffe Blvd.; Springmount Ave., from Oakwood Ave. to n.l. lot No. 30, plan M-312. Brick Block Pavement—Waverley Rd., from 1,300 ft. n. of Queen St. to Kingston Rd. Concrete Pavement—Belsize Drive, from Yonge St. to Mt. Pleasant Rd. (except the intersection of Wilfred Ave.); Manor Rd., from Yonge St. to e.s.l. Oswald Cres.; Sheldrake Blvd., from Yonge St. to Sheldrake Ave.; Sheldrake Ave., from n.s.l. Sheldrake Blvd. produced to Beulah St. running south. Grading—Benson Ave., from Hendrick Ave. to Ossington Ave. Concrete Curbings—Annette St., s.s., from Keele St. to Aziel St.; Elmsley Place., e.s., from St. Joseph St. to 350 ft. n. and w.; Elmsley Place, w.s., from St. Joseph St. to 380 ft. n. and e.; Front St., n.s., from John St. to Spadina Ave.; Middleton St., n.s., from Sheridan Ave. to Brock Ave.; Waverley Rd., w.s., from 1,488 ft. 6 in. n. of Queen St. to 165 ft. 8 in. farther north; Waverley Rd., e.s., from 1,501 ft. n. of Queen St. to 171 ft. farther north. Concrete Sidewalks—Atlantic Ave., w.s., from King St. to 1,190 ft. south; Bellefair Ave., w.s., from 14 ft. 6 in. s. of n.s. Juniper Ave. to 349 ft. 6 in. south; Cherokee Ave., from Lake Shore Ave. to Iroquois Ave.; Eastern Ave., s.s., from Morley Ave. to 139 ft. 2 in. west; Erie Terrace, e.s., from Queen St. to Gerrard St.; Kenilworth Ave., e.s., from Queen St. to 1,421 ft. north; Kenilworth Ave., w.s., from 1,228 ft. s. of Kingston Rd. to 593 ft. farther south; King St., s.s., from 92 ft. w. of Dowling Ave. to 509 ft. 6 in. farther west; McGregor Ave., s.s., from Durie St. to Runnymede Rd.; McLean Ave., e.s., from Queen St. to 1,128 ft. south; Nothcliffe Blvd., w.s., from Regal Rd. to St. Clair Ave.; Ranleigh Ave., s.s., from 892 ft. e. of Yonge St. to Ronan Ave.; Silver Ave., s.s., from Golden Ave. to 307 ft. 4 in. east. T. L. Church, chairman, Board of Control.

Treherne, Man.—Tenders will be received by R. J. Mills, secretary-treasurer, Municipality of South Norfolk, Treherne, Man., up to noon on September 29th for grading. Approximate quantity, 9,000 cubic yards. Specifications may be obtained from the office of the Good Roads Board, Parliament Buildings, Winnipeg, or from the secretary-treasurer.

Victoria, B.C.—Tenders will be received until 12 o'clock noon, October 15th, by the department of railways, for supply and erection of steel for superstructure of Deep Creek viaduct on the P.G.E. Ry. Plans, etc., office of P.G.E. Ry., Vancouver block, Vancouver, and at the department, Victoria. A. F. Proctor, chief engineer.

Winnipeg, Man.—Residents of River St. have asked for removal of car tracks and construction of an asphalt pavement. Estimated cost, $40,000. J. Cockburn, alderman.

Tarvia

Preserves Roads
Prevents Dust~

Queenston & Grimsby Stone Road, Lincoln County, Ont. Tarvia-filled macadam in 1916. Finished with "Tarvia-B" in 1917.

A view of Jordan Hill section of the Queenston & Grimsby Stone Road in Lincoln County, Ont. Tarvia-filled macadam in 1916. This road was treated in 1917 with "Tarvia-B."

Auto-Tank Sprayer distributing Tarvia

County of Lincoln (Ont.) adopts Tarvia for all main highways—

The following letter from Mr. Lewis H. Collard tells the story of the experience of the County of Lincoln, Ont., with Tarvia roads. It proves again that Tarvia solves the good road problem satisfactorily and economically, and that Tarvia highways will stand up under the heaviest kind of traffic.

Mr. Collard writes :

" I feel that if I did not give you an unsolicited testimonial of my experience with your Tarvia products, I would not be doing my duty to my fellow municipal officers in the Dominion of Canada, who may have under their consideration the building of some more permanent highways than the old water-bound macadam type.

The County of Lincoln two years ago built about two miles of Tarvia road on its main highway from the village of Jordan, running west, better known as the Queenston & Grimsby stone road, a road which carries the traffic from Canada to the Niagara Frontier and from the United States to Hamilton, Toronto, and farther east, and therefore is one of the heaviest travelled roads in the Province of Ontario, both in tourist and local traffic, having as high as one thousand automobiles and trucks passing over it in a day, and I can only say, after two years of this kind of traffic, the road is in first class condition to-day, and has pleased the County of Lincoln so much that they intend to build their main highways in the County Road system of the same type."

(Signed) LEWIS H. COLLARD,
Chairman, Lincoln County Roads

Nothing more need be said, except to remind you again that no matter what your road problem may be—whether you require a road binder, a dust preventive, a road preserver, or a patching material—there is a grade of Tarvia for the purpose.

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MONTREAL TORONTO WINNIPEG ST. JOHN, N.B. HALIFAX, N.S. SYDNEY, N.S. VANCOUVER

Welland, Ont.—The highways department, Ontario, has finally approved construction of concrete pavement in the village of Ridgeway. Contract for this work was awarded, early in July, to Begy & Co., St. Catharines, at $29,500. Albert Nelson, chairman, good roads committee.

West Vancouver, B.C.—Contract has been awarded by the department of works to Cotton Co., Ltd., for re-surfacing Marine Drive. Contract price, $2,650.

Windsor, Ont.—A by-law to provide $30,000 for construction of sidewalks in various parts of the city has been endorsed by the ratepayers.

Winnipeg, Man.—The transportation committee of the city council has recommended the repaving of River Ave. City engineer, W. P. Brereton.

Winnipeg, Man.—Bonds will be issued by the provincial treasurer for construction of additional good roads. Bond issue, $250,000. Hon. E. Brown, treasurer.

Winnipeg, Man.—Canadian National Railways awarded contract for extension to power house, Winnipeg, to H. Edwards, Winnipeg, and contract for section houses, C.G.R. line, to J. H. Simmons, Winnipeg.

WATER SEWAGE AND REFUSE

Belleville, Ont.—An outlet for the large drain being constructed on West Moira St., has been secured, by purchase, from the Pringle estate.

Belleville, Ont.—Council contemplates construction of a sanitary sewer on Commercial St., from Dundas St. to West Bridge. Estimated cost, $6,339. J. G. Mill, city engineer.

Galt, Ont.—City council will construct sewers on Huron and James Sts., and on Myrtle Ave., with an outlet through Dickson Park.

Halifax, N.S.—Contract has been awarded by the city council for completion of construction of sewer and water services on Agricola St., abandoned by W. F. Lecuyer, to Dow and Kaiser. Contract price, $1,867. Rejected tenders from Robertson and Hanrally, $2,480; Cook and Dembrack, $2,755; J. A. Chousse, $3,425. F. W. W. Doane, city engineer.

Hamilton, Ont.—The lower end of the Clark Ave. sewer will be raised and relayed to Ferrie St. New sewers will be constructed on Ferrie St. from Clark Ave. to Cathcart St. E. R. Gray, city engineer.

Lucknow, Ont.—Tenders will be received until October 11th, by the council of township of West Wawanosh, county of Huron, for construction of the Kirk drain, estimated excavation, 12,675 cu. yds., and the J .B. Young drain, estimated excavation, 15,572 cu. yds. W. A. Wilson, clerk.

New Liskeard, Ont.—Council has authorized construction of sewer and water mains from Whitewood Ave. to R. G. Howie's property.

Regina, Sask.—City council will commence drilling at Boggy Creek to obtain increased supply of water.

Smiths' Falls, Ont.—Town council will construct sewers on Thomas St. and on Robina Ave. from Smiths' Falls Ave. to Chambers St.; and on King St. from Robina Ave. to Smiths' Falls Ave.

Toronto, Ont.—Tenders will be received until noon, September 30th by the board of control, for excavating, laying and jointing of 24 in. water pipes, valves and special castings on Victor Ave. Plans, etc., at water main extension section, city hall. T. L. Church, chairman.

Winnipeg, Man.—The concrete pipe line and intake under construction by the Greater Winnipeg Water District will be entirely completed by November 1st.

York Township, Ont.—Contracts have been awarded by township council for construction of water mains as follows: To Orsiny Construction Co., Pinewood Ave., etc., $2,-312.50. Rejected tenders from Angelo Cavotti, $2,515, and Peter Isles, $3,479.50. To Peter Isles, West Morningside Ave., etc., contract price, $4,240. Rejected tenders from Orsiny Construction Co., $4,724.50, and Angelo Cavotti, $4,-708. Frank Barber, engineer.

York Township, Ont.—Township council has received approval of railway board for construction of 12 in. trunk water mains on Bathurst St., Connaught and Lonsdale Aves.

York Tp., Ont.—Tenders will be received until noon, October 4th, by township council for construction of 6-in. cast-iron water mains in the following streets: (1) Belvidere Ave., 680 lin. ft. (2) Forest Hill Rd., Huron St., Burton Rd., Claremount and Westmount St., 6,097 lin. ft. (3) Sunnybrae Cres., Denarda St., 1,535 lin. ft. (4) Corbett Ave. and Mould Ave., 2,009 lin. ft.; 12-in. cast-iron water mains on (5) Bathurst St., Lonsdale west and Lonsdale east, 3,490 lin. ft. Frank Barber, 40 Jarvis St., Toronto, engineer.

LIGHT, HEAT AND POWER

Halifax, N.S.—The Nova Scotia water powers commission will obtain reports regarding the Indian and the North East river with the view of developing the water powers. E. H. Armstrong, chairman.

Hamilton, Ont.—The Parks Board accepted the tender of R. Fitzsimmons for installing boilers at the greenhouses at Gage Park for $1,450. The only other tender was from W. J. Walsh for $1,596.

Highland Creek, Ont.—The Iroquois Gravel Co. will receive power from the Hydro-Electric system. It is expected that the surrounding district will obtain a domestic lighting system at the same time.

Islington, Ont.—Etobicoke council has requested the Hydro-Electric Commission to construct street lighting system on Oliver Ave., Humber Bay district.

Mt. Lehman, B.C.—Council will ask the Western Canada Power Co. to supply electric power to the farmers in the Fraser valley.

Nelson, B.C.—The Mankin Lumber and Pole Co. will construct a flume line, 3 mls. long, from Hall creek to the mill site.

Sydney, N.S.—The Nova Scotia Steel and Coal Co. may electrify its present railroad system.

Truro, N.S.—Town council decided to enlarge electric lighting plant. A 150-300 k.w. turbine generator and a 400 h.p. boiler will be installed. Estimated cost, $50,000. J. G. W. Campbell, town engineer.

Winnipeg, Man.—Bonds will be issued by the provincial treasurer for construction of the first section of the provincial hydro system. Bond issue, $250,000. Hon. E. Brown, treasurer.

York Township, Ont.—Residents of Pendeen Ave. and of Bexley Cres. have petitioned council to construct extensions of hydro lighting system.

RAILWAYS

Charlottetown, P.E.I.—The first standard gauge train on the P.E.I. Ry. was run recently, from Borden to Summerside and Charlottetown.

London, Ont.—City council contemplates purchase of the London Street Railway system. By-law will probably be placed before the ratepayers next January. H. A. Brazier, city engineer.

Quebec, Que.—A spur line railway will soon be constructed from the main line to the new developments in the iron ore fields, province of Quebec. M. J. O'Brien and S. N. Parent, Quebec.

Toronto, Ont.—The Hydro-Electric Power Commission will construct the hydro-radial from Toronto to Pickering, as soon as the township of Scarboro guarantees bonds to the extent of $900,000, and the township of Pickering bonds to the extent of $300,000. Deputy reeve Crocker, Birchcliff.

Toronto, Ont.—The proposed entrance for the Toronto-Pickering hydro-radial would cost $4,328,665. Plans have been prepared by the Hydro-Electric Power Commission, and a by-law will probably be placed before the ratepayers January 1st. F. C. Gaby, chief hydro engineer.

BURLINGTON
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Windsor, Ont.—The city council has notified the Sandwich, Windsor and Amherstburg Street Railway Co. of intention to purchase upon expiration of the franchise in 1922. It is expected that the Ontario Hydro-Electric Power Commission will buy and control this railway and operate in conjunction with hydro-radials to St. Thomas, Brantford, Hamilton and Toronto. E. B. Winters, mayor.

Winnipeg, Man.—The Manitoba government has decided to build 72 mls. of railway into the mining district north of Le Pas this winter, if the Dominion government will not. Hon. Edward Brown.

FACTORIES AND LARGE BUILDINGS

Belleville, Ont.—A modern dairy building will be erected on the Cumming estate on Coleman St. C. Whelan, Belleville.

Brandon, Man.—Tenders will soon be called for construction of the proposed hospital. Plans, which are practically completed, call for a capacity of 200 beds.

Canso, N.S.—A cottage hospital will be erected and equipped as a soldiers' memorial. Capacity, 10 to 12 beds.

Ford City, Ont.—Contract has been awarded by school board for construction of new separate school to Wells and Gray. Contract price, $140,000. J. C. Pennington, architect.

Fort William, Ont.—A grant of $112,000 has been made by the provincial government toward the cost of construction of a technical school to be built in Fort William.

Fredericton, N.B.—A committee has been formed to prepare plans and estimates of cost of constructing and equipping a building in connection with the University of New Brunswick, where technical work may be carried on for benefit of returned soldiers.

Galt, Ont.—Contract for the construction of the one-story, stone bank building for the Bank of Toronto, has been awarded to the Dickie Construction Co., Ltd., Toronto.

Guelph, Ont.—The Chamber of Commerce have secured a site on Cambridge St. for the erection of a skating rink, which will likely be built this fall at a cost of about $50,000.

Hamilton, Ont.—At a recent meeting of the Parks Board, chairman Alfred Wright presented plans for a stadium and athletic field which it is proposed to build in the east end of the city. The plans call for an expenditure of $100,000.

Hamilton, Ont.—Contract has been awarded for construction of one 4-story reinforced concrete factory, 56 by 146 ft.; 3 buildings, 63 by 362 ft., 123 by 144 ft., and 81 by 62 ft.; 1 office building, 62 by 45 ft., as follows: W. H. Yates, Hamilton, Ont., general contract; Hamilton Bridge Co., Hamilton, steel; Trussed Concrete Steel Co., Toronto, reinforcing steel; J. B. Ormsby Co., Toronto, steel sash. W. J. Westaway Co., Hamilton, architect and engineers for the Porrits and Spencer Paper Manufacturing Co. A. Sande, resident engineer.

Kitchener, Ont.—A. B. Pollock Manufacturing Co. will build an extension to their plant.

Kitchener, Ont.—The Lang Tanning Co. will erect two warehouses. Estimated cost, $24,000.

Kitchener, Ont.—Contract has been awarded by the Ames-Holden Tire Co. to Dunker Bros., for construction of a two-story felt factory in Hall's lane.

Kitchener, Ont.—Negotiations are under way between W. N. McEachern and Sons, Ltd., house builders, and a number of manufacturers in this city to have from twenty to thirty houses built this fall in each of the five wards of the city.

Medicine Hat, Alta.—Contract has been awarded for construction of courthouse as follows: Steelwork, Dominion Bridge Co., Ltd., Winnipeg; steel sash, Trussed Concrete Steel Co., Walkerville, Ont. Total cost, $132,000.

Midland, Ont.—The Midland Whitewear and Costume Co. contemplates additions to factory and installation of new machinery. J. N. Graham, manager.

Montreal, P.Q.—It has been announced that the Canadian Pacific Railway Co. intend to rebuild the Place Viger Hotel in the near future into a modern hotel of ten storeys.

Montreal, P.Q.—Plans have been prepared by Chas. M. Mitchell, architect, Montreal, for the erection of an arena on Mount Royal Ave. for the National Sporting Club, Ltd., now in process of incorporation. The plans also call for the erection of eight stores.

Peterborough, Ont.—Contracts for construction of South Central school to be known henceforth as Memorial school, have been awarded by the board of education as follows: General contract to Graham and Hayes, $159,963; heating and ventilating, to R. C. Sturgeon and Co., $32,145; plumbing, fixtures and drainage to G. Brenton, $13,000; electric wiring and conduits to Miller, Powell and Watson, $2,747. Contracts awarded total $207,855. Additional costs for grading, walks, water connections, equipment, etc., will increase total cost to $240,000.

Purple Springs, Alta.—Tenders will be received by the Board of Trustees of School District No. 3761 of Skiff at the office of O. J. Graham, secretary-treasurer, Purple Springs, Alta., up to noon, September 30th, for the erection of a frame school building. Plans and specifications may be obtained from the secretary-treasurer.

Regina, Sask.—Contract has been awarded for construction of round house addition for the G.T.P. Ry., to Carter, Halls and Aldinger. Contract price, $15,000.

Regina, Sask.—The congregation of the Fourteenth Ave. Methodist church contemplates construction of a new church building. Rev. P. Iveson Thacker.

Retlaw, Alta.—Tenders will be received by the Board of Trustees of School District No. 3810, Retlaw, at the office of M. Watterberg, secretary-treasurer, up to noon, September 30th, 1919, for the erection of a frame school building. Plans and specifications may be obtained from the secretary-treasurer.

Sarnia, Ont.—The International Bushings Co., Ltd., will erect a plant in the near future. C. E. Calvert, Toronto, president.

Sedgewick, Alta.—Contract for plumbing, heating and ventilating the new eight-room school has been awarded to Ross Bros. Plumbing and Heating Co., Ltd., Edmonton.

Sherbrooke, Que.—In order to house the increased staff of workers which will be required when the Connecticut Cotton Mills doubles the size of the present plant, the Sherbrooke Housing Co. has been proposed. A model housing scheme will be developed in the western section of the city.

South Vancouver, B.C.—The G.W.V.A. have appointed a committee to report on project of constructing houses under day labor plan.

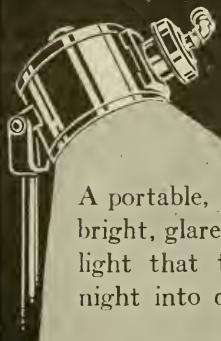
St. John, N.B.—Tenders will be received until 12 o'clock noon, October 6th, by the Department of Public Works, Ottawa, for construction of a grain conveyor (the equipment not being included) in St. John harbor, West St. John, N.B. Plans, etc., office of engineer-in-charge, St. John; district engineer, Shaughnessy building, Montreal, Que., and Equity building Toronto. R. C. Desrochers, secretary.

St. Thomas, Ont.—The St. Thomas Cabinets, Ltd., will establish a factory to manufacture gramaphone cabinets.

St. Thomas, Ont.—Contract has been awarded by the board of education to A. E. Ponsford for construction of an addition to Myrtle St. school. Contract price, $50,830; heating to Hamilton and Scott, $8,393; plumbing to J. A. McKenzie, $2,152.18; wiring to Roberts and Sandham, $325; heat regulator to Johnson Co., Toronto, $1,059; total cost, $62,759.68. Rejected tender, Sanders and Bell, $66,881.

Three Rivers, Que.—The International Paper Co., Ltd., is erecting a plant, consisting of eighteen buildings. Total estimated cost, $6,000,000.

Toronto, Ont.—Construction of the new electrical building for the University of Toronto has again been resumed.



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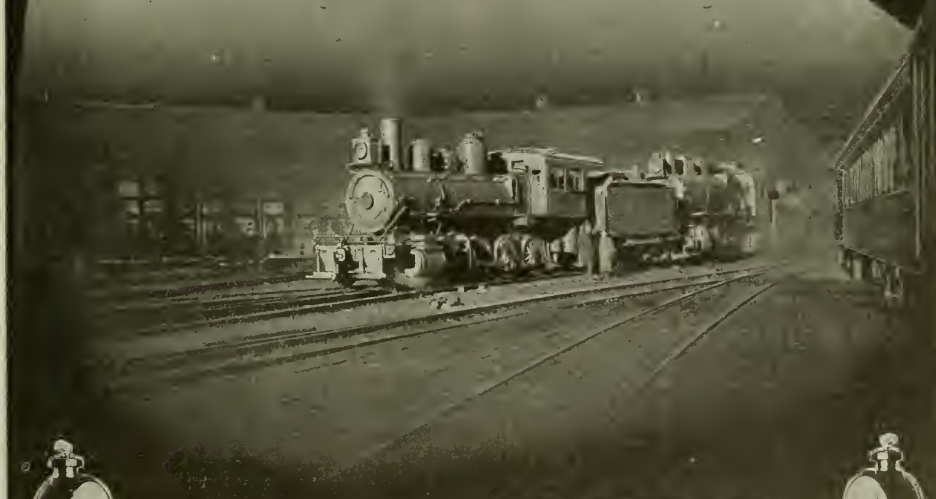

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HALIFAX TORONTO REGINA VANCOUVER

Toronto, Ont.—City council will erect temporary bleachers in Riverdale and Willowvale Parks to provide accommodation for winter sports. Estimated cost, $2,400.

Toronto, Ont.—Stadium plans, recently prepared by the city architects department, include grandstand with dressing rooms, $47,000; grandstand without dressing rooms, $42,000; two bleachers, each $7,300; wooden fence, $5,450; and four ticket offices, $1,000. Total cost, exclusive of track, $110,050. Seating capacity, 10,000.

Toronto, Ont.—The board of directors, Canadian National Exhibition, Toronto, is considering elaborate plans for proposed extensions, including enlargement of transportation building, art gallery and grandstand and new buildings, arena, cattle barns, machinery hall, two large lavatories, large central restaurant, hospital, women's rest at east end of grounds, live stock hospital, education and music building, building for lost children and a dog building. John G. Kent, manager.

Vancouver, B.C.—By-laws have been prepared providing for alterations and additions to schools. Estimated cost, $181,500. Wm. McQueen, city clerk.

Vancouver, B.C.—The Gregory Tire and Rubber Co., Ltd., are preparing plans for construction of a reinforced concrete tire factory to be 200 ft. long and 80 ft. wide.

Walkerville, Ont.—An additional grant of $200,000 has been received by the Walkerville Housing Commission.

Waterloo, Ont.—Contract has been awarded by the park board for construction of a comfort station to Louis Holle.

Welland, Ont.—Plans have been completed and construction will soon commence on the new three-story building for the Bell Telephone Co.

Windsor, Ont.—The United Hotels Co. will construct a large modern hotel. Estimated cost, $1,000,000. F. L. Dudley, president.

Windsor, Ont.—As a result of the passing of the by-law, granting for 10 years a fixed assessment of $10,000, the Fisher Closed Body Co. will construct a plant to manufacture auto bodies.

Winnipeg, Man.—The Manitoba Government Telephone Commission will construct a large garage, fireproof construction. Estimated cost, $51,200. J. H. Russell, architect.

Winnipeg, Man.—The Tavani Electric Steel Co., Belleville, Ont., are contemplating construction of a steel and iron foundry in Winnipeg. Estimated cost, $5,000,000.

Woodstock, N.B.—Plans are in contemplation for the erection of several new buildings at the Woodstock Fair grounds.

MISCELLANEOUS

Amhertsburg, Ont.—Tenders will soon be called for channel construction in the lower Detroit river.

Glace Bay, N.S.—Messrs. Green and Smith, representing English capital, contemplate construction of a shipyard as well as the $5,000,000 drydock.

Hamilton, Ont.—Parks Board awarded contract for the erection of a new wharf at Wabasso Park to the Canadian Engineering and Construction Co. for $34,400. Other tenders received as follows: McAllister and Taylor, $43,000, and W. T. Brennan and Co., $43,317.

Lethbridge, Alta.—Farmers, north of Lethbridge, representing owners of 208,000 acres, have endorsed the erection of the Lethbridge northern irrigation project. Vote was taken under terms of the Alberta Irrigation District Act.

Lethbridge, Alta.—By order-in-council, the federal government has provided that all the unappropriated waters of the St. Mary, Milk, Belly, Old Man and Waterton rivers and their tributaries in Alberta shall be reserved for purposes of irrigation.

London, Ont.—City engineer Brazier proposes to establish a plant for manufacture of cement tile to be used in storm sewer construction.

Montreal, Que.—The administrative commission will be urged by the city council to enlarge the St. Dennis St. tunnel. Alderman Carmel.

Moose Jaw, Sask.—Public school board contemplates construction of an enclosed fire-escape for use at Alexandra School. Estimated cost, $4,000. G. D. Mackie, city engineer.

New Glasgow, N.S.—Ratepayers have authorized issue of bonds to provide for purchase of equipment for street purposes. Estimated cost, $7,500.

Ogdensburg, Ont.—Contract has been awarded by the department of public works, Ottawa, to the Daly Dredging Co., for dredging Ogdensburg harbor. Contract price, $65,000. Estimated excavation, 360,000 cu. ft. R. C. Desrochers, secretary.

Peterboro, Ont.—Contract has been awarded by department of railways and canals, Ottawa, for rebuilding north pier at Farran's Point, to McGuire and Cameron.

Prince Albert, Sask.—Excavation for the new east cell wing for the penitentiary has been started. R. F. Uniacke, structural engineer, Dominion government penitentiaries.

Regina, Sask.—Tenders will be received until 4.30 p.m., September 29th, by the highway department, province of Saskatchewan, for excavation for the following reservoirs: N.W. ¼ sect. 10-25-22, west of 3rd meridian, Snipe Lake post office; n.e. ¼ sect. 15-28-20, west of 3rd meridian, south of Brock; n.e. ¼ sect. 21-27-24 west of 3rd meridian, south of Fairmont. H. S. Carpenter, deputy minister.

Rimouski, Que.—Tenders will be received by the monument committee until October 30th for the erection of a soldiers' memorial monument. C. A. Couillard, secretary.

Saskatoon, Sask.—Contracts have been awarded by the School Board for installation of heating, ventilating and plumbing systems for the Mayfair School to Chas. D. Kirk Co., Winnipeg. Contract price, $50,310. Contract for metal work was awarded to A. L. Charlebois, Saskatoon. Contract price, $5,060.

St. Catharines, Ont.—Doheny, Quinlan and Robertson, contractors on section No. 3, Welland ship canal, have received orders from the department of railways and canals, Ottawa, that construction work on section No. 3 be closed indefinitely.

St. John, N.B.—Tenders will soon be called for supplying 10,000 lin. ft. granite curbing. G. N. Hatfield, city engineer.

Sydney Mines, N.S.—Nova Scotia Steel and Coal Co. contemplate construction of a new by-product plant, necessitating construction of an additional blast furnace. Estimated cost, $3,500,000.

Sydney, N.S.—The Dominion Iron and Steel Co. contemplate enlarging the capacity of the open hearth by addition of newer and larger furnaces, which will cost several million dollars.

Toronto, Ont.—New tenders will soon be called for construction of a steel crane for the city of Toronto. T. L. Church, chairman, board of control.

Toronto, Ont.—The projected St. Lawrence river development as outlined by Sir Adam Beck, include construction of dams at Morrisburg and at Long Sault.

Vancouver, B.C.—Dredging operations under the contract recently awarded to the Pacific Dredging Co. for the North Arm, Fraser River, have commenced. Yardage to be excavated, 1,000,000 cu. yds. Time of completion, March 6th, 1920.

Winnipeg, Man.—Bonds will be issued by the provincial treasurer for additional telephone construction. Bond issue, $250,000. Hon. E. Brown, treasurer.

Winnipeg, Man.—City council has instructed the works committee to examine thoroughly into the selection and preparation of a suitable site for an airdrome.

Winnipeg, Man.—Contracts have been awarded by the city council for supply of two 3.5-ton trucks for the city engineer's department to the Grace Motor Co. Contract price for two Sterling trucks, $11,500.

The Canadian Engineer

A Weekly Paper for Civil Engineers and Contractors

Operation of Drifting Sand Filters at Toronto

Average Reduction of 85.4% in Total Bacteria and of 94.8% in B. Coli During Year 1918—Chlorination Killed Practically all Remaining Bacteria—More Coagulant Needed in Summer Than in Winter—Water Undergoes Two Distinct Changes During Year

By NORMAN J. HOWARD

Bacteriologist-in-Charge, Filtration Plant Laboratory, Toronto

PURIFICATION of the water supply for the city of Toronto is effected by means of two systems, one being a slow sand and the other a mechanical of the drifting sand type. The water is drawn from Lake Ontario to the south of Toronto Island, two intakes being situated a little over 2,000 feet from the shore, submerged in about 60 and 80 feet of water, respectively. The slow sand system has given excellent results, but when an extension was found necessary in 1914, the city decided on mechanical filtration, the reasons given being difficulties in operation caused by a combination of occasional high turbidity and the low temperature in the winter months.

The object of this paper is to give, as briefly as possible, a description of the drifting sand system* and the results of the operation and purification effected during 1918. Throughout the paper the word "gallons" are Imperial gallons. The capacity of the plant is 60 million gallons in 24 hours, but a maximum rate of 72 million gallons daily must be maintained for a period of 10 hours. The rate of filtration is somewhat higher than is usual with mechanical plants, the rate being 150 million gallons per acre per day. Before describing the plant it would be well to state the two principles involved in its operation. They are the introduction of a coagulant without sedimentation and the necessity for there being a drifting as well as a stationary body of sand in the filter. These would seem to be the two differences between modern mechanical plants of the gravity type and the drifting sand filter.

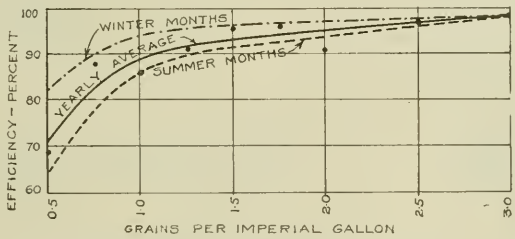


DIAGRAM OF BACTERIOLOGICAL EFFICIENCIES OF TORONTO'S DRIFTING SAND FILTRATION PLANT DURING YEAR 1918, SHOWING EFFECT OF INCREASING ALUM DOSE

In the Toronto plant the water flows by gravity from the intake into a suction well, where the coagulant is introduced, the water then being pumped directly to the filters.

The coagulation plant consists of a large storage bin in which is stored alumina sulphate used for coagulation purposes. Through a number of control doors the chemical is automatically fed to two dissolving channels, the density of which is kept from 12 to 14 degrees Baume (about 15% solution). The strong solution passes into a hydrometer chamber, where it is automatically diluted to the required strength. The hydrometer is poised in the solution between two valves, one discharging alum and the other water. Any vertical movement of the hydrometer opens one valve and closes the other. Thus the hydrometer tank is supplied with strong alum solution at the top, or water at the bottom, depending whether the hydrometer is up or down. The tank is made of concrete, whilst the hydrometer is steel, thickly covered with paraffin wax, and has a displacement of 6,000 lbs. of solution. It is weighted so as to just float in solutions of alum ranging between 4% and 10%. Owing to the differences in the density of alum and water, circulation is maintained, a 10% solution of alum being approximately 5% heavier than water. The heavier liquid coming in at the top immediately starts travelling downwards and meets the lighter liquid rising upwards. At the point of discharge a perfect mixture is obtained, it being impossible to detect stratification.

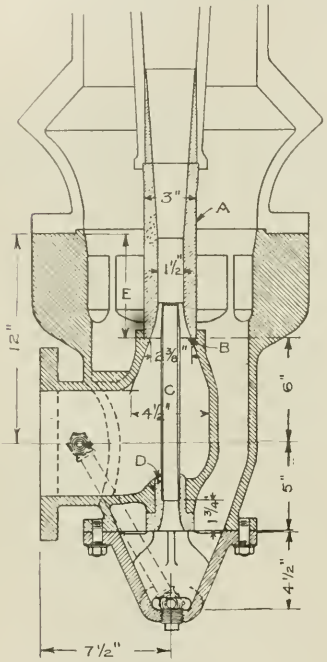
A beam with knife edges above the hydrometer, which is extremely sensitive, provides for permanent adjustment and also for altering the density of the solution. Along the beam is a scale of divisions graduated in 1/10th grains, so that by moving a weight the required strength of solution may be obtained. The solution of alum next discharges into an orifice chamber. A mechanical device regulates the discharge of solution, which is proportionate to the quantity of water being pumped, this being indicated by a Venturi meter which is directly connected with the measuring slot.

From the measuring tank the alum passes through lead pipe to the suction well and is pumped to the filters. The lift of water from the well to the filters is 32 ft. The pumping station includes three electrically driven pumps with a combined capacity of 100 million gallons and a lift of 32 ft. Besides these, there are a two-million gallon auxiliary pump with 32-ft. lift, two half-million gallon backwash tank pumps with 100-ft. lift, two one-million gallon drainage pumps with 20-ft. lift and two hydraulic-pressure pumps with a capacity of 8,640 gallons a day under 700 lbs. per square inch. The discharge of the main pumps is controlled automatically by the level of the water in the filter tanks, through pilot valves, operating hydraulic valves on the discharge of the pumps. There has also been installed a steam turbo-generator set, in case the electric power should fail.

The multiple filter unit system was adopted in Toronto, and consists of ten units, each having a nominal capacity of six million gallons. Each filter is made of steel, is 14 ft. high, 50 ft. in diameter, and is divided into thirty smaller units. These units are nested together in two rings of 18

*For photographs, plans, sectional drawings and further data regarding the construction and method of operation of this plant, the reader is referred to the following issues of *The Canadian Engineer*: October 24th, 1918, pp. 359-64; September 14th, 1916, pp. 203-10; November 25th, 1915, pp. 618-20; April 8th, 1915, pp. 433-8; April 23rd, 1914, pp. 639-41.

and 12 respectively. In the centre of the filter is a space 16⅔ ft. in diameter, in which is placed the raw water control balance. Each of the thirty units form a separate quadrilateral unit with sand extractors, sand washer and filtered-water-collecting system. For backwashing, an overflow channel 15 ins. wide and approximately 3 ft. deep is placed round the outer ring. At the bottom of each filter, partly embedded in the concrete, is a cast-iron collector pipe for the filtered water. Running out from the collector pipe are a series of 1½-in. wrought iron sheradized pipes, having ⅜-in. holes drilled on the underside, spaced about 6 ins. apart. These pipes have a cap on the outer end and the inner end is screwed into the cast-iron collector. On the top of the pipes is rounded gravel in three grades, varying from ¾ in. to ⅜16 in., to a depth of 10 ins., and above that is 9 ft. of sand.



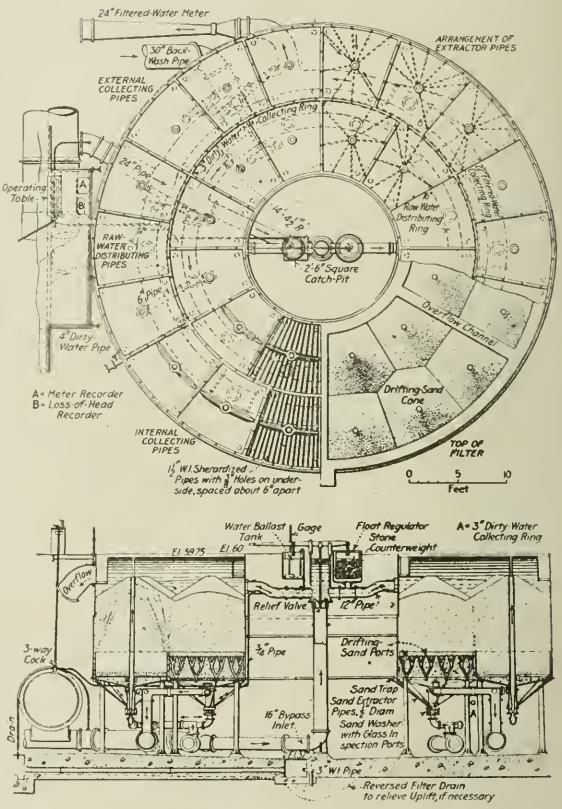
New Type of Sand-Washer Now in Use

(A) Throat made of drawn-steel tube, hardened right through; (B) thin rubber washer; (C) standard ¾-in. wrought iron pipe, hardened right through; (D) mild steel, hardened right through; (E) collar on throat to be set so that throat projects 6 1/16 ins. below flange face without compressing rubber ring at the top.

that the flow of sand from each extractor pipe can be observed. The sand washers are of cast iron. The throats are relined when occasion arises with wrought-iron pipe liners, specially hardened by a carbonizing process. The liners are in three steps and are 13½ ins. high.

Description of Process

The coagulant is introduced as the water goes direct to the filters, on the suction side of the pump. Owing to the operation of the drifting sand system, the sand contained in the filters resolves itself into two bodies—a stationary sand body supported by the gravel resting on the water collecting system and a drifting sand body lying between the surface of the stationary sand and the sides of the filter.



Details of Drifting Sand Filter at Various Horizontal and Vertical Planes

The total amount of sand in each filter is 600 cubic yards. No screens are used between the gravel and the sand. The sand has an average effective size of .375 mm., and a uniformity coefficient of from 1.6 to 2. Around each small unit is a system of slots and the drifting sand is withdrawn from the filter by means of extractor pipes, through which the sand flows to the bottom of the filter unit into a sand washer. At the sand washer the sand falls to the bottom through a current of raw water and is thus cleaned. It is picked up by the incoming raw water and carried back to the filter. The dirty water impurities or suspended matter pass upward and out at the top of the sand washer by an outlet suitably controlled. A water jet is provided to assist the flow of sand through the extractor pipes, and, below the point of discharge, a glass inspection port is provided, so

By causing the sand to drift across the path of the raw water, a large proportion of the impurities, including the aluminum hydrate and the bacteria that have been caught by the coagulant, are carried out along with a portion of the drifting sand. The stationary sand takes out the remaining impurities. The treated raw water enters the filter partly by a standpipe running through the centre of the unit, which passes through a sandwasher in the bottom, and delivers above the sand at the top of the pipe, and partly through a by-pass. Within the sandwasher the raw water pipe is constructed similar to that of the tube of a Venturi meter and the drifting sand after being collected and washed in the sandwasher, is inducted into the raw water at the throat of the Venturi tube. This sand passes up the stand-pipe with the raw water and is delivered at the top of the filter.

The drifting sand forms a volcano-like cone that continuously drifts away and is being replaced with the washed sand from the sand washer, leaving a round top body of stationary sand below, resting upon the filtered water collecting system. The final purification is dependent on this body of stationary sand. The rate of flow of water passing through the by-pass may be varied in such a way as to suit the conditions of the raw water. In times of high turbidity the speed of the drifting sand is accelerated by decreasing the flow of raw water through the by-pass and increasing the flow through the standpipe. When in operation the stationary body of sand is found to be hard and compact with a cone-shaped-like surface, which is hard to penetrate.

The drifting sand is quite buoyant and spongy and offers little resistance to penetration. In practice it is found that the slope of the drifting surface cone is a minimum of about 32 degs. and the slope on the surface of the cone forming the stationary sand is about 64 degs. The initial loss of head in the filters is 6 ft. and in the process of operation this gradually increases to 11 ft., when the filter is backwashed.

Length of run of filters ranges between one and seven days according to the physical condition of the raw water and the amount of alum applied. Backwashing is accomplished by reversing the flow of filtered water through the bottom of the filter. The water is obtained from an elevated tank having a capacity of 200,000 gals. and which, on account of its elevation, supplies a natural head of 40 lbs. Half the contents of the tank are passed through the filter at a gradually increasing rate, the first 100,000 gallons taking fifteen minutes, whilst the remaining quantity is passed through rapidly, the whole operation being completed in 20 minutes. The filter is then run to waste for 20 minutes, after which it is put into commission. The amount of dirty waste water passing through the sand washer is 2%, whilst an additional 1% to 2% is used for backwashing and waste purposes.

On a big plant, embracing an entirely new system, it was expected that numerous problems would be encountered, particularly when the plant was put in commission, but with few exceptions, the difficulties have, or will be shortly, overcome, and in no case can they be considered serious. In the early days, the biggest problem was to get a high grade sand. About two-thirds of the sand originally placed in the filters, amounting to over 4,000 cubic yards, had to be taken out and replaced at the expense of the contractors. At present the sand, whilst being satisfactory, is not quite uniform, having an effective size which varies between .35 and .4 mm. In the chemical house some inconvenience was caused by the corrosive action of the aluminum sulphate solution on the slotted trunk through which the solution is discharged into the raw water. The trunk was made of vanadium silver, which has since been replaced by one made of pure copper. Tests are at present being conducted in the laboratory on a composition consisting of copper 92 parts, lead 8 parts containing 1% of antimony.

The question of sand scour has been the most troublesome. When the filters were first put in commission, the cast-iron throats did not wear as long as was expected, and they were relined, first with extra heavy black iron pipe and finally with similar pipe carbonized. Porcelain was tried but was unsuitable and experiments with rubber are now under way. Most of the scour observed has been traced to a tail eddy which forms at the back of the sand nozzle by the water passing it. By using the modified sand washer the scour has been greatly reduced, and a number of new washers are being installed.

Some trouble was caused in one filter by too rapid backwashing, which resulted in the disturbance of the gravel. The filter was emptied and the gravel replaced by 4 ins. of 1-in. gravel, and 6 ins. of cemented gravel, in the proportion of 15 of gravel to 1 of cement. The gravel used was the material which passed through a screen having three meshes to the inch and was retained on a screen having five meshes to the inch. This has proved to be very satisfactory.

Table 2.—Average Number of Bacteria per cc. Growing on Standard Agar 24 Hours at 37-39 Degs. C., in the Raw, Filtered and Chlorinated Water, Together with Percentage Reduction

Month	Raw Water	Filtered Water	Mixed Mechanical and Slow Sand Water Chlorinated
January	42.2	3.3	1.2
February	7.4	1.2	1.0
March	43.0	3.2	1.6
April	73.4	5.6	1.0
May	28.7	5.7	1.1
June	108.5	11.4	2.8
July	97.1	19.9	1.4
August	653.0	67.3	2.4
September	738.7	82.5	1.4
October	1,382.5	29.1	2.5
November	779.8	78.1	2.7
December	534.4	33.3	1.4
Yearly average	369.5	53.4	1.72

Per Cent. Purification Effected in Agar:—

A. Average of 303 samples: Raw water, 369.5; filtered water, 53.4. Average of 1,900 samples, chlorinated water, 1.72. Total average reduction:—In filtered water, 85.4%; in chlorinated water, 99.5%.

B.—Same exclusive of three results for reasons specified in article:—Raw water, 303.6; filtered water, 34.7; total average reduction, 88.4%.

Table 1.—Average Amount of Water Filtered Daily, Together with Monthly Average of Applied Aluminum Sulphate and Turbidity in the Raw and Filtered Water

Month	Av. Amt. of Water Filtered, Million Imperial Gallons	Av. Amt. of Aluminum Sulphate Applied in Grains per Gallon	Turbidity: Raw Water Max.	Raw Water Min.	Raw Water Av.	Filtered Water Max.	Filtered Water Min.	Filtered Water Av.
January	30.95	0.98	80	1	6.2	Under 1	Under 1	Under 1
February	33.16	0.65	24	1	3.9	"	"	"
March	33.63	0.92	54	1	12.7	3	"	"
April	32.49	1.48	160	1	27.9	18	1	2.4
May	32.74	1.04	7	1	2.1	Under 1	Under 1	Under 1
June	31.76	0.82	2	1	1.3	"	"	"
July	39.13	0.61	3	1	1.5	1	"	"
August	38.00	1.08	10	1	1.8	1	"	"
September	36.9	1.02	25	1	2.8	Under 1	"	"
October	40.61	1.2	4	1	1.4	"	"	"
November	44.19	1.07	35	1	2.9	"	"	"
December	37.7	1.3	75	1	21.3	"	"	"
Yearly average	36.0	1.027	..	.	....			Under 1

The average amount of chlorine applied to the water was 0.2 parts per million.

Preliminary Experiments

Prior to the completion of the new drifting sand plant at Toronto, extensive laboratory experiments were carried out over a period of eighteen months, the object being to collect as much data as possible that would likely be of value when the plant was put in commission. After six months' observation it became evident that the water of Lake Ontario was going to be an extremely difficult water to treat mechanically; that is to say, the purification effected after coagulation, under apparently the same physical conditions, varied from time to time It was generally known that the quality of the water was governed by the meteorological conditions, which also controlled the temperature of the water.

In the summer months, when the water was warm and the wind from an unfavorable direction, there was invariably pollution. During the winter months the same unfavorable meteorological conditions produced a polluted water which showed a drop in temperature instead of an increase

such as usually occurred in the summer months. This was explained by off-shore currents, which carried the shore water out and at the same time met and mixed with the polluted water, which, in turn, was carried across the intake.

For the laboratory experiments two small rapid sand filters were built and sterilized. Raw water, treated with amounts of aluminum sulphate ranging between one-half and three grains per Imperial gallon, was then passed through under varying conditions at the rate of 120 million Imperial gallons per acre per day. The removal of bacteria in the effluents was pro rata to the quantity of alum applied, the results being strikingly uniform.

The time element was next studied, and the tests were made to determine what difference existed in the final purification between treated water after fifteen minutes' coagulation and after a period of three hours' coagulation and sedimentation. Little differences were noted, and the opinion was formed that the time element was not a factor in the resultant purification. Similar experiments were carried out in Ottawa with river water by Jos. Race, city bacteriologist, and he found that the results between periods of two and one-half minutes and two hours were substantially the same. Tests were duplicated in the warm weather, and it was then noticed that the purification figures obtained under similar physical conditions in the summer months, were considerably lower than were obtained in the winter months. In 1918, when enough units of the new plant had been completed so as to allow testing to be carried out on a large scale, many of the observations proved of great value, and showed that the coagulation trouble that had been anticipated, actually worked out similarly to what occurred in the laboratory in the small experimental filters. Amongst other observations made were the resulting purification after coagulation and filtration of:—

1. Lake Ontario water containing different degrees of turbidity.
2. Lake Ontario water free from pollution.
3. Lake Ontario water heavily polluted, winter conditions.
4. Lake Ontario water heavily polluted, summer conditions.
5. Temperature conditions of Lake Ontario water.

Turbidity did not help or hold up purification at any time of the year. The only effect was to cause an increased amount of alum to be applied at such times as was considered necessary for clarification purposes. Water free from pollution offered no difficulties. In the winter months a polluted water required at least one and one-half to two and one-half grains of alum in order to get a satisfactory effluent. During the summer months it was found necessary to apply at least two and one-half grains per Imperial gallon to a polluted water which often was free from turbidity. Water slightly polluted required about one grain per gallon. No satisfactory explanation of the varying conditions can be offered, although much experimental work has been carried out to determine what are the controlling influences.

No doubt temperature plays an important part, although it has been generally conceded that warm water aided coagulation. In Toronto the raw water appeared to coagulate slightly better in the summer months when the water temperature exceeded 50 degs. F., but the final purification effected was lower than in the winter period when the water temperature ranged between 33 and 46 degs. F.

The microscopic content showed great increase in summer months, as also did the total number of bacteria present; these, again, might be a contributory cause. The most logical idea is that the colloidal content of the water in some months was largely responsible for the conditions noted, and that a direct relationship existed between the microscopical, bacteriological and colloidal content. When the preliminary tests on the drifting sand experimental plant of one-half million gallon capacity were carried out in 1914 by Col. Nasmith and Capt. Adams, Humber Bay water was used (this was Lake Ontario water into which the Humber River flowed), and splendid efficiencies of over 98% were obtained on a test period of 36 consecutive days.

Purification Effected in 1918

With the object of showing the different degrees of purification effected in the two seasons of the year, the writer has grouped the results into two periods, the first being from December to May, and the second from June to November. The month of June produced a water that was easy to treat at all times, but for classification purposes was placed in the second period.

The appended tables show:—

1. Average amount of water filtered; amount of aluminum sulphate applied; turbidity in raw and filtered waters.
2. Average number of bacteria per cc. growing on standard agar in 24 hours' incubation at 37 degs. C. in:—

(a) Raw, filtered and chlorinated water, together with percentage reduction in filtered and chlorinated water, all results included.

(b) Same as above, exclusive of three results for reasons specified.

3. Same figures, classified under summer and winter groupings.

4. Tests for typical B. coli, 48 hours at 37-39 degs. C., showing number of days in raw, filtered and chlorinated water; indicated number of B. coli per 100 and 1 cc. in the raw and filtered water, together with the total percentage reduction.

(a) All results included.

(b) Exclusive of three results for reasons specified.

It has been previously mentioned that the raw water is subject to rapid changes. Frequently the water becomes heavily polluted after less than eight hours' change in the meteorological conditions. This makes the treatment exceedingly difficult, as occasionally a sudden pollution has occurred and an insufficient quantity of alum applied, with the result that the efficiency of the plant has been impaired.

Regarding the expression of results, inclusive and exclusive, no doubt some explanation should be offered for same. The results excluded are one in September and two in October, the reasons being that on two occasions abnormal pollutions occurred when the bacterial count in the raw

TABLE 3.—SHOWING THE VARIATION THAT OCCURS IN THE EFFICIENCIES IN THE WINTER AND SUMMER MONTH PERIODS

	Average number of bacteria per cc. in the raw and filtered water with percentage reduction.		Number of days that B. coli was present in raw and filtered water, with percentage reduction.											
			Raw Water.						Filtered Water.					
Month.	Raw Water.	Filtered Water.	100cc.	10cc.	1cc.	.1cc.	.01cc.	.001cc.	100cc.	10cc.	1cc.	.1cc.	.01cc.	
WINTER PERIOD.														
December	534.39	33.35	25	23	18	11	5	1	25	16	9	1	0	
January	42.23	3.31	22	11	8	1	0	0	13	7	0	0	0	
February	7.42	1.21	24	15	2	1	0	0	22	8	2	0	0	
March	42.98	3.24	23	17	7	3	0	0	19	10	3	0	0	
April	73.44	5.62	24	19	13	6	0	0	23	10	6	0	0	
May	28.73	5.62	25	15	5	0	0	0	24	13	2	0	0	
Removal 92.8%.									Total Removal 97.8%.					
SUMMER PERIOD.														
June	108.54	11.38	21	14	2	1	0	0	18	4	0	0	0	
July	97.08	19.92	22	14	4	1	0	0	24	14	3	0	0	
August	653.2	67.31	26	24	15	4	0	0	26	23	9	0	0	
September	738.6	128.80	24	19	11	5	0	0	24	16	10	0	0	
October	1,382.46	290.5	26	21	15	9	0	0	26	18	7	2	0	
November	779.6	33.32	24	13	7	1	0	0	25	19	7	0	0	
Removal 84.1%.									Total Removal 75.8%.					

water was in the neighborhood of 15,000 per cc. and at the same time an insufficient quantity of coagulant (1.5 grains per gallon) was being applied. On the other occasion the alum was reduced too soon following a change in the direction of the wind. When chemical tests were made it was found that the water was still polluted, and consequently the alum was again increased. During the intervening period the sample was collected and proved to be unsatisfactory. As will be seen from the figures, the inclusion of these three results materially alters the average number of bacteria present, and also lowers the colon efficiency. The average number of bacteria per cc. growing on standard agar, 37-39 degs. C., was 369.5 in the raw and 53.4 in the filtered, inclusive of all results showing an average reduction of 85.4%. Excluding three records for reasons previously specified, the figure was 303.6 in the raw and 34.7 in the filtered, with an average reduction of 88.4%. The indicated number of B. coli per 100 and 1 cc. was 612 and 6.12 in the raw and 31.70 and .317 respectively in the filtered, with a total average reduction of 94.8%. If the three records before mentioned are excluded, the raw water would show 608 per 100 cc. and 6.08 per 1 cc., whilst the filtered water figure would be 22.0 per 100 cc. and 0.22 per 1 cc., with an average percentage reduction of 96.0%. The chlorinated water showed an average bacterial count of 1.72 per cc., whilst only two samples out of 1,900 samples examined showed the presence of B. coli in 1 cc. This gives a total removal of 99.9%.

Table 4.—Tests for Typical B. Coli, 48 Hours at 37-39 Degs. C., Showing Number of Days Present in the Raw, Filtered and Chlorinated Water; Indicated Number of B. Coli per 100 and 1cc. in the Raw and Filtered Water, Together with the Total Percentage Reduction

A.—All results included. B.—Exclusive of three results for reasons specified.

Month.	Raw Water 100cc.	10cc.	1cc.	0.1cc.	0.01cc.	0.001cc.	Number of Samples	Filtered Water 100cc.	10cc.	1cc.	0.1cc.	0.01cc.	Chlorinated Number of Samples Positive 1cc.	Chlorinated Percentage of Samples Negative 1cc.
Jan.	22	11	8	1	0	0	26	13	7	0	0	0	0	100
Feb.	24	15	2	1	0	0	24	22	8	2	0	0	0	100
Mar. ...	23	17	7	3	0	0	25	19	10	3	0	0	0	100
Apr.	24	19	13	6	0	0	25	23	10	6	0	0	0	100
May ...	25	15	5	0	0	0	26	24	13	2	0	0	0	100
June ...	21	14	2	1	0	0	24	18	4	0	0	0	1	99.4
July ...	22	14	4	1	0	0	26	24	14	3	0	0	0	100
Aug. ...	26	24	15	4	0	0	26	26	23	9	0	0	1	99.4
Sept. ...	24	19	11	5	0	0	24	24	16	10	0	0	0	100
Oct.	26	21	15	9	0	0	26	26	18	7	2	0	0	100
Nov. ...	24	13	7	1	0	0	26	25	19	7	0	0	0	100
Dec. ...	25	23	18	11	5	1	25	25	16	9	1	0	0	100
Totals	..286	205	107	43	5	1	303	269	158	58	3	0	2	99.9

A.—Indicated number of B. coli:—Raw water, 612 per 100cc.; filtered water, 31.70 per 100cc. Total reduction inclusive of all results:—Filtered water, 94.8%; chlorinated water, 99.9%.

B.—Indicated number of B. coli:—Raw water, 608 per 100cc.; filtered water, 22 per 100cc. Total reduction exclusive of three results for reasons specified, 96%.

Particular attention has been given to the clarification of the water, and it would be well to point out that the turbidity figures given are only those actually occurring at 9 a.m. daily. During the month of April, the figure in the raw water ran up as high as 550 parts per million, and the maximum figure recorded in the table as occurring in the filtered water followed this high period of turbidity. The raw water figure given in the table as 160, was the degree of turbidity actually present in the raw water half an hour previous to the collection of the filtered water sample, this being the estimated time for the water to pass through the filter from the time the coagulant was first added. It would seem to be scientifically incorrect to give only one set of figures, as a wrong impression might easily be formed.

The original specifications called for certain efficiencies being obtained on an average amount of one grain per Imperial gallon of aluminum sulphate, this figure being largely based upon the results obtained at the experimental plant on the Humber Bay water in Toronto. As a result of practical experience on the mechanical filtration of Lake Ontario water, considerable modification has had to be made as regards the operation of the new plant. Conclusive evidence has been forthcoming from experiments and borne out by actual results, that Lake Ontario water cannot be bacteriologically purified to a high degree by mechanical filtration when only an average dose of aluminum sulphate of one grain per Imperial gallon is applied. The actual purification effected by the drifting sand filters in 1918 was on an average application of 1.027 grains per Imperial gallon, and the results obtained on such a small amount are satisfactory. It has been clearly demonstrated (see diagram) that if a higher dose of alum be applied, a corresponding degree of purification is obtained. The economical question, however, had to be taken into consideration on account of the enormous cost of aluminum sulphate, and when it is considered that during periods of high pollution as much as 2.5 grains per gallon was applied, a definite economy as well as a practical policy of operation had to be adopted.

The summary of conclusions formed are as follows:—

1. That Lake Ontario water can be treated effectively by mechanical filtration.
2. During the year the composition of the water appears to undergo two distinct changes, which make the treatment of the water difficult.
3. That in the summer months more coagulant is necessary than in the winter period.
4. That the purification effected by the drifting sand filters during 1918, upon an average dose of 1 grain per gallon of alum, was satisfactory.

The plant is operated by the Department of Works, Commissioner R. C. Harris being the head of the department, with A. U. Sanderson as superintendent of the plant. The filtration laboratories, under the Department of Health, determine the amount of coagulant necessary. An excellent understanding has always existed between the two departments and close co-operation on the plant has made its operation a simple matter. Our policy of operation as at present defined is:—

1. Treat raw water at all times with sufficient aluminum sulphate to clarify the effluent effectively.
2. Obtain as high a bacterial efficiency as possible on an average dose of one grain per Imperial gallon.
3. Leave final sterilization to chlorine.

In conclusion, I would quote the last paragraph from the official report on drifting sand filters, October, 1918, by Col. G. Nasmith and the writer, which reads as follows:—

"The decision we arrived at when the tender for the mechanical plant was first let, 'That our former conception of a filtration plant was undergoing a material change; that sterilization of the water was the vital thing, from the public health standpoint, but that a filter was essential to clean the water, to keep the sand and dirt out of the water supply, and thereby prevent the wear and tear of machinery valves, taps, etc., as well as prepare the water for efficient sterilization; and that for a great portion of the year only a fraction of a grain of aluminum sulphate in conjunction with a slight amount of chlorine would be essential for filtration, thereby resulting in a great saving in the cost of operating,' has been generally confirmed as a sound one, not only by ourselves, but by sanitarians in civilian and army work the world over." (See *The Canadian Engineer*, issue of October 24th, 1918, page 361.)

In connection with the preparation of this paper, I am indebted to Col. Geo. Nasmith, director of laboratories; A. U. Sanderson, superintendent of the plant; and Messrs. Hannon and Thompson, of the filtration laboratory staff, for their advice and assistance.

SOME ASPECTS OF THE SALVAGE AND WRECKING BUSINESS

By G. Gordon Cottrell
Formerly Manager of The Dominion Salvage & Wrecking Co., Ltd., Toronto

PREVIOUS to the great war, the nations of the North American continent were probably listed as the greatest wasters in the world. With seemingly inexhaustible mines and boundless forests, why should we conserve? Why use the old when the new could be obtained so easily and cheaply? Four years of destruction and expense have taught us the error of our ways. We are now living in an age of reconstruction and utilization. It has taken a great war to awaken us into new activities and make us realize that there is such a thing as a limit to our resources.

With the dawn of a brighter day, the cry has gone forth for reconstruction and production to the utmost. But before we can build the new we must clear the ground of the old, and here is where our experience, so dearly bought by the exigencies of war, should be utilized for peace.

What are Wrecking Companies?

Probably every architect, builder and contractor knows that there are organizations designated as "wrecking companies," but if one familiar with the subject were to question these same architects, builders and contractors as to the functions of the wrecking and salvage organizations, he would receive such a number of diverse and hazy replies that he would have food for many hours' mirth or meditation, according to his mood. Yet there is a reason for this vague and often unfavorable opinion among the building fraternity, as will be shown later.

What is a wrecking company? The replies are interesting. "An aggregation of irresponsible grafters, with no financial backing, trying to get something for nothing," answers the architect. "Wreckers? You mean junk-dealers and one-horse lumbermen," retorts the contractor. And so it goes. Yet this attitude of ignorance and disregard is unfair to construction men, wrecking companies and the public in general.

Recently in conversation with the manager of one of the largest wrecking and salvage companies in Canada, I mentioned some of the replies received to the foregoing question, and his answer is enlightening. "We are neither junk-dealers nor 'one-horse' lumbermen," he said. "Our business is to secure sound, used material, either by wrecking buildings or direct purchase, which we in turn sell at a big saving on current market prices. At all times we maintain a staff of engineers and lumbermen, familiar with building requirements and the requirements of builders. Our stock is composed of good, sound material only; should your requirements happen to be of such a peculiar nature that we cannot fulfil them satisfactorily, no attempt will be made to foist something 'just as good' upon you."

Varied and Interesting Departments

This may come as a revelation to those who, either through ignorance or prejudice, try to deny the usefulness of the modern wrecking company. The gentleman above quoted was referring to one department only—the retail. Yet a large wrecking company contains some of the most varied and interesting departments of any business known. To consider them all in an article of this length would be impossible. However, a brief outline of the main divisions will be attempted.

The activities of any large wrecking company naturally fall into three classifications—namely, tendering and securing contracts; engineering and demolition work; and finally, disposal of material acquired. Obviously, the ability to secure contracts should go hand in hand with the ability to "sell service" and satisfactorily complete the contracts received, but strange to say this is not always the case. As previously mentioned, many of the architects and contractors have a totally erroneous opinion as to the wrecking business, and instead of endeavoring to award their business to the most reliable firm doing the best work, they look for the one which will pay the most. This is another fallacy of the wrecking game, and one which has served to keep out the better class of men from entering the business on a big scale. How can a firm, employing trained men, paying good salaries for qualified superintendents, and with a heavy overhead expense for office upkeep, bid as much for contracts as the little fellow who keeps no books, employs only the cheapest labor, and is bookkeeper, superintendent, manager and company all in one? Architects and contractors have formed their bad opinions of the wrecking companies from these irresponsible pirates.

The Wrecking "Pirate"

The wrecking pirate is the scourge of the business. With no financial backing, and therefore nothing at stake, he is free to come and go, employing the cheapest labor, generally foreign. He has no office, keeps no set of books, pays no taxes, and is everything from office boy and laborer to president of his own activities. If his profits amount to approximately what a large company would pay a capable man in wages, he is satisfied. Yet contractors continue to award their business to these fellows, and then, when they get a poor job, crudely done, in return, they loudly proclaim all wreckers as "irresponsible grafters!" If, when these same contractors have work to award, they would pay more attention to the personality and ability of the parties tendering, instead of considering who will bid the most, they would not only be rendering themselves a service but the wrecking industry as well.

There is still another phase of the business-getting department which will, no doubt, be familiar to many contractors. This is the owner or architect who thinks that estimates should be "cheerfully furnished, free."

Within the past few years, a determined effort has been made by organized contractors and builders to abolish the expensive practice of submitting estimates on speculation, yet many seem to consider that this does not apply to the wrecking contractor. One of the largest items of expense in connection with the wrecking and salvage business is that of "Preliminary Estimating Expense," which annually amounts to thousands of dollars through estimating on work which is never even let.

Cost of Estimating

Many owners seem to feel that wrecking companies should gladly prepare estimates without even the assurance that work will be started, and here, again the wrecking pirate accommodates them, while indirectly increasing the expense. It costs money to send an experienced estimator out to examine a prospective job. Often I have received "rush" letters advising that tenders were desired on a certain job within the next few days. That meant dropping all other work, and perhaps calling in the chief superintendent from some job out of the city. After rushing him to the scene of the proposed work, paying all his travelling expenses, and in addition thereto the time, labor and expense of taking his figures, computing the expense of the job and submitting a tender on time, we were finally advised that the owner had been merely contemplating the work and did not intend doing anything definite until the high prices dropped.

This is no exaggeration. I personally know the owners of a certain building who annually call for tenders as regularly as winter melts into spring. For three years now they have annually called for tenders on a "rush" job, yet the building is still standing and in all probability will continue to do so, at least until the present ownership changes. All this preliminary estimating expense helps to swell the cost of doing business, and it is the larger and more stable concerns who feel it most. Small concerns doing business for but a few months will never have the experience or expense above mentioned, so they submit estimates indiscriminately, with the result that all others must do likewise or run the risk of falling into disfavor.

However, we will assume that our clients mean business, and have awarded us the contract. After the agreement has been signed, the actual wrecking operations begin. No two jobs are the same, so no fixed procedure will suffice. The wrecking contractor must always bear in mind that his

profit comes solely from the resale of the material acquired. He must, therefore, endeavor to carry on the work of demolition with the main object of salvaging practically all of the material, while at the same time remembering that it must be done expeditiously and in a manner satisfactory to the owner or architect. Also, he must use fine discrimination; far better to smash certain sections outright than adopt ultra-cautious methods of salvage and so boost the expense to such a point that the material finally available, costs more than its selling value.

Smashing vs. Scientific Wrecking

Modern business demands speed and efficiency, and this is as true of the wrecking business as any other. The problems of party walls, loads on girders and removal of floors are not for the amateur. It is now generally conceded among the larger wrecking concerns, that only experienced men of brains and initiative can qualify as superintendents, and good salaries must be paid. Even yet, some of the old-timers fight against this tendency towards expert wrecking, but emphatically there is a vast difference between smashing down a building slip-shod and wrecking it scientifically. Scientific wrecking means something. Not long ago I was asked to bid on a job, and the owner, thinking my tender too low, decided to do the work himself. Accordingly, he engaged a few inexperienced laborers, equipped them with picks and sledge-hammers and began. The resulting wreck would have cheered the heart of a dealer in kindling-wood or tooth-picks. Certainly there was some good "wrecking." But when the owner came to sort out the material available for sale, he found so little left that the proceeds did not near compensate him for the expense of demolition! It was simply proof that bull-headed smashing cannot compete with scientific wrecking methods.

While all the larger wrecking organizations maintain yards and warehouses, it is the general policy to sell as much material as possible directly off the job. This benefits both the seller and the buyer; it assists the contractor to clear away his material as the work proceeds, and also eliminates the expense of loading, trucking to the yards, unloading and holding for sale. He can therefore afford to sell for less directly off the job than from stock, although the buyer may not have the same selection to choose from.

As the job nears completion, provision must be made for closing up the work within the time specified in the contract, and all the material is trucked directly to the yards and passed into stock. It then comes under the charge of the yard superintendent, who must be a natural trader and possess a wide knowledge of values, as they relate to all kinds of merchandise. Electrical fixtures and supplies, plumbing material, radiators, boilers, mantels, mirrors, stained and fancy glass, valves, machinery and all kinds of building material pass into his care. Not only must he be able to judge the age and condition accurately, but in addition he must keep in touch with the various market fluctuations, so that he will never be in the unpleasant position of having salvaged material for sale at prices higher than new material would command. A yard superintendent should possess wide powers; he should have full authority, for instance, to lower prices on slow-selling commodities and thus clear them out, rather than fill his warehouse with material for which there is but slight demand through insisting on higher prices set by some executive not in touch with the trade.

Success in Quick Sales

As in all other lines of merchandizing, the success of the retail end of the wrecking business depends on quick turn-overs. Keep the stock moving. As the retail division controls the profit or loss of the business, it demands close attention, and every effort should be made to satisfy customers and treat prospective purchasers with courtesy. This is not always the easiest thing in the world to do, for owing to the pecularities of the business, many of the day's callers are persons "just looking around." They have no definite idea as to what they want, and seem to feel that the yard superintendent should give them several hours of his time, if necessary, simply pulling down material for their inspection. Turning these vague prospects into actual purchasers demands real salesmanship.

In addition to their ordinary facilities for handling lumber, most of the larger companies now maintain sawmills for their own exclusive use. This is something of an innovation to the wrecking industry, but one which has proved most satisfactory. Where a company is doing a large business and taking large quantities of lumber into stock, there soon accumulates a vast quantity in unsaleable sizes.

Generally speaking, a large proportion of the unsold material off contract jobs, remains unsold, simply because it is in large or odd sizes, and forwarding this to the yard simply means stocking up with unsaleable material. The usefulness of a good mill, capable of resawing this timber into saleable sizes is at once apparent.

To be of use, a mill should contain both swing and rip saws capable of cutting the largest sizes of dimension timber. In several instances companies have installed small mills with cheap equipment, but have found to their cost that instead of being assets they are but bills of expense.

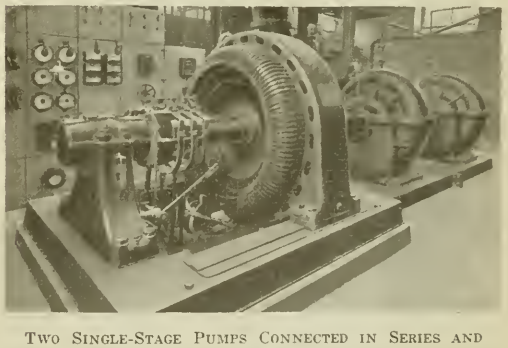
At this stage, one may ask: "What are the possibilities of the wrecking business?" Let me say right here that at the present time there is actual need for a large wrecking organization, and when I say "large," I mean it in every sense of the word.

TEST SHOWS 82.1% OVER-ALL EFFICIENCY OF MOTOR-DRIVEN CENTRIFUGAL PUMP

By R. N. Austin
Manager, Turbine Equipment Co., Ltd., Toronto

THAT the efficiency of centrifugal pumps is still climbing, and that under certain circumstances water works' pumps can be profitably operated with central-station power, is shown by the report of an acceptance test made upon a motor-driven pump at the Minneapolis water works.

In a paper read before the Minnesota section of the American Water Works Association, F. W. Capellen, city engineer of Minneapolis, states that in May, 1911, the city entered into a ten-year contract with the Minneapolis Gen-



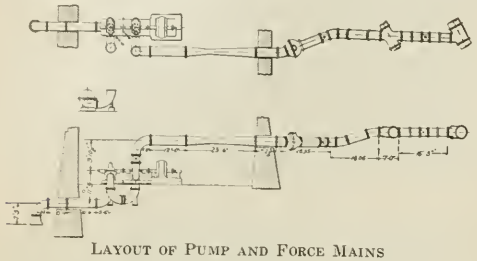
Two Single-Stage Pumps Connected in Series and Driven by Induction Motor

eral Electric Co., now the Northern States Power Co., by which that company agreed to furnish current at 2,200 volts to operate two or more 20,000,000-gal. pumps (throughout this article the word "gallon" means "U.S. gallon"), against a dynamic head of 240 ft., based upon a pumping set of 72% over-all efficiency, at a price of $4 per million gallons pumped, the understanding being that no current would be used between 4.15 p.m. and 6.30 p.m. on week days during the months of November, December, January and February.

In November, 1916, a similar ten-year contract was made with the same company for the operation of a 30,000,000-gal. pump against the same head, and with the same pump efficiency, to be charged for at the same rate, with the provision that at a different dynamic head or efficiency, the price per million gallons should be adjusted accordingly.

It was also specified that the motor to be used by the city should be capable of starting the pump when primed and with the check or gate valve in the discharge closed, and of bringing the pump to full speed without drawing more than 150% of full load current from the source of supply. In 1910 and 1911, two 20,000,000-gal. Worthington pumps were installed, and in 1918, a De Laval pump.

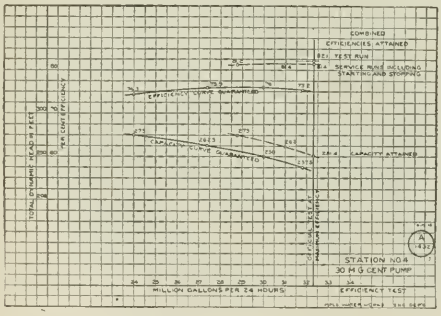
The latter unit consists of a General Electric 1800-h.p., three-phase, slip-ring induction motor directly connected to two De Laval 24-in. single-stage pumps, mounted upon the same base-plate and connected in series. The unit was specified to deliver 30,000,000 gals. per 24 hours, against a total



Layout of Pump and Force Mains

dynamic head of 250 ft. It is installed at pumping station No. 4 in North-East Minneapolis.

In the official acceptance test, the discharge was measured by means of a Venturi meter, the capacity being calculated from manometer readings, while the discharge head was measured by two sets of calibrated gauges and the suction lift by means of a mercury column. The power supplied was measured by three sets of watt-hour meters, calibrated by means of a portable set of standard instruments read during the official test under the conditions of current, voltage and power factor obtaining. The portable set included two single-phase watt meters, one polyphase watt meter, one volt meter, four ammeters, and portable current and potential transformers. All instruments were checked and cali-



Capacity and Efficiency Curves, Showing Results of Test

brated in the presence of witnesses. The test lasted 28 hours. The results were as follows:—

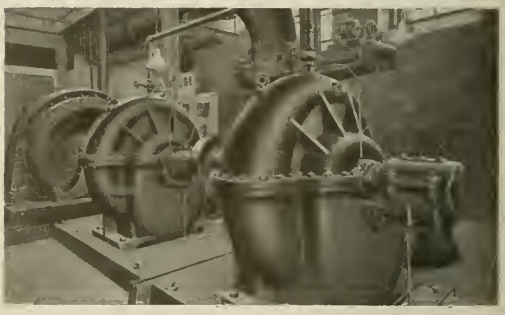
Total pumpage in 28 hrs.	37,719,500 gals.
Rate per 24 hrs.	32,331,000 gals.
Discharge head, average	235.13 ft.
Suction lift, average	16.43 ft.
Total dynamic head, average	251.56 ft.
Kilowatt hours used	36,307.2
Combined efficiency of motor and pump	82.1%
Average line voltage	2,406
Power factor	90.0%
Motor efficiency under test conditions	[illegible]
Slip of induction motor	1.1%
Temperature rise	33.5 degs. C.
Starting current, percentage of full load current	113.0%

The contract provided a bonus of $500 for each 1% of efficiency exceeding 76% when pumping 30,000,000 gals. per day against a total dynamic head of 250 ft. The maximum bonus was limited to $2,400. A penalty of $500 was provided for each 1% by which the efficiency might fall below 76%, and the pump was not to be accepted if the over-all efficiency fell below 72%.

As the accompanying chart shows, 76% efficiency was exceeded at all loads tested, and the average combined efficiency, including the regular starting and other conditions incidental to a varying load in regular service, should not be less than 82.1% by more than 1%. The over-all efficiency of 82.1% divided by the motor efficiency of 95.5% gives a pump efficiency of 85.97%. This is believed to establish a new record.

Service runs extending over a period of three months show an excess of 5% over the efficiencies stipulated in the contract for various heads.

The test was accepted as correct by J. E. Jensen, supervisor of the water works department, and E. C. York, engineer of pumping stations. The foregoing information is taken from the official test of the report by Prof. F. W. Springer, of the University of Minnesota, who was in full charge of the test, so far as the city was concerned.



Another View of the 30,000,000-Gal. Unit

The following operating data were obtained during the first three months after the test:—

Gallons pumped	2,797,490,000
Power cost per million gals.	$3.63
Labor and supplies per million gals.	$2.27
Total cost per million gals.	$5.95
Head, ft.	253.06
Over-all efficiency, per cent.	81.4

Similar records for the first nine months subsequent to the test are as follows:—

Gallons pumped	6,526,350,000
Power cost per million gals.	$3.72
Labor and supplies per million gals.	$1.77
Total cost per million gals.	$5.49
Head, ft.	255.80
Over-all efficiency, per cent.	82.48

Figures are also available from two triple-expansion pumps installed in the same plant in 1903 and 1904, and tested in September, 1904. These pumps have a capacity of 15,000,000 gals. per day each, and on test developed a duty of 162,000,000 ft.-lbs. per 1,000 lbs. of steam, reduction being made for slip. During 1908 the two steam pumps raised practically all of the water for the city—namely, 6,518,000,000 gals. against 250 ft. head. The cost of fuel, using Illinois screenings at $2.07 per ton, was $3.01 per million gals., the cost of labor $3.33, and other pumping costs 35 cents per million gals., making a total of $6.75. The cost to-day, with coal at $4.93 per ton, would be approximately $12.74 per million gals. The low prices which the city realizes on its power contracts with the electric company are, of course, explainable in that the contracts were made some time ago and for a long term.

Canada Must Develop Her Great Fuel Resources

Dependence Upon Supply from United States is National Menace Despite Best Intentions of that Country — International Problem for Engineers and Statesmen— Address Delivered August 22nd at Annual Convention of Canadian Gas Association

By ARTHUR V. WHITE
Consulting Engineer, Commission of Conservation of Canada

APART from the maintenance of the proper morale of the nation and of the sources and distribution of food, there is, I believe, no question involving physical matters which is of such vital issue to Canada as her fuel problem. As some of you know, for many years and whenever occasion has offered, I have been emphasizing the gravity of this problem and the need for taking prompt and adequate national action respecting its solution.

To-day, although having in mind the annual coal shortage again menacing us, I desire, nevertheless, to treat our subject more in its broader aspects.

Although we have had coal shortages in Canada and a measure of accompanying distress, yet, after all, the great mass of our people have been practically unharmed by the stress of coal conditions. It may not always be so. Through failure to deal adequately and in a broad, statesmanlike manner with her national coal problem, Canada courts trouble and, I believe, may yet experience such a "pinch" with respect to her fuel supplies as will seriously affect her economic welfare. Is it not of the deepest significance that Herbert Hoover in the early part of this month, speaking as head of the International Relief Organization of Europe, stated that "the fate of European civilization now rests in the hands of the coal and coal mine owners of Europe to an equal if not a greater degree than in the hands of the producers of foods and supplies during the next year?" Mr. Hoover contends that only greatly increased coal production and an improved organization for its distribution can save Europe from disaster during the coming year.

As already mentioned, we in Canada have been comparatively free from experiencing the keener distresses of coal privation. It is true that during previous coal shortage many people have had to get along from hand to mouth. Coal has had to be doled out in small lots and in 1917-18, I understand, was even expressed in 100-lb. parcels to effect relief in certain localities, and so on; but speaking generally, we, nationally, have not had anything like the distress respecting fuel which has been extensively experienced by European countries.

Some European Coal Conditions

Let us begin by briefly surveying certain present world coal conditions, and as we do so kindly bear in mind one fact, namely, that the United States, which furnishes us with so large a part of our annual coal supply, has now become much more closely associated with world markets and world conditions. She is rapidly assuming a premier position as a coal exporter, and older European countries are eagerly looking to her for "first aid." In our survey it will be appropriate to consider coal statistics as applicable in 1913—just before the war.

The countries of western and southern Europe even in normal times are badly circumstanced for fuel. France, Italy, Norway, Sweden and Portugal have been largely dependent for their coal on Great Britain. In 1913, Britain supplied for export to continental Europe about 50,000,000 tons of coal of which France took 20,000,000 tons, Italy 9,650,000 tons, Sweden 4,569,000 tons, Norway 2,300,000 tons, Spain 3,650,000 tons, Denmark 3,030,000 tons, Holland 2,010,000 tons, Portugal 1,360,000 tons, other Mediterranean countries 3,500,000 tons. In addition Great Britain sent about 9,000,000 tons to South America and 5,000,000 tons to other parts of the world.

Britain's exported coal before the war constituted in point of value 8½%, and in point of weight 7½%, of her total export trade. This coal serves as ballast for outgoing boats and enables them to return to home ports with raw material and foodstuffs. It is evident therefore what prime bearing Britain's coal industry has to her export trade. What are the conditions in Great Britain to-day? At the present time, owing to exhaustion of stocks, to shorter hours of labor, to decrease of transportation facilities, to strikes —including the recent coal miners' strike, alone involving 250,000 men—Great Britain's annual rate of production has fallen about 70,000,000 tons short of pre-war conditions. If the restrictions on her home consumption are removed, it has been estimated that she may have 7,000,000 tons of coal for export during the coming year. It the restrictions are maintained, this amount may be brought up to 28,000,000 tons. But even if all this coal were shipped to western and southern Europe, there would for these areas still result a deficiency of more than 25,000,000 tons. This leaves out of consideration South America and other portions of the world previously supplied by Britain.

Coal Conditions in France

In France, the coal mines destroyed by the Germans—both wantonly and for military necessity—formerly produced 20,000,000 tons per annum. French engineers state that it will take from two to five years to rebuild the operating equipment, and ten years to completely restore the production rate of these mines. France, however, will be able to increase her fuel supplies owing to the occupation of the Sarre District. But she has to replace her former importation where deprived of same. France still faces serious coal shortage.

Italy's condition with respect to fuel throughout the war period has been desperate. In 1913 she was producing less than 750,000 tons of coal per annum and, as we have seen, was importing from Great Britain some 10,000,000 tons. During the war, at great expense, she was able to increase her home production of an inferior grade of fuel by about 1,000,000 tons. This month Italy has ordered that 300,000 tons of her shipping sail for American ports to return with coal.

In Germany, fuel conditions are represented to be exceedingly bad. On August 6th, at the coal conference of experts from all parts of Germany to devise means for increasing the production of coal "so that Germany will not freeze or starve during the coming winter," the chief result arrived at in the preliminary meetings of the conference has been to emphasize the fact that the German situation also is desperate. It was recognized, however, that hard and intelligent work alone will contribute to alleviate the distress. Avenues for effort are being determined. Germanly has succeeded in inducing France to admit that the supplying of her demand of 40,000,000 tons of coal annually would be a physical impossibility; and Germany further represents that she cannot hope to supply even enough coal for her own most urgent needs. She certainly will be hard pressed to find surplus coal with which to discharge, as she must first do, her obligations to France. German counsellors have recommended that it will be best to sacrifice some of their national forests. Some industries which formerly used coal as fuel are now attempting to use wood. It is interesting to observe that in the tentative German plans for priority of those who are to receive coal it has been laid down that the first claim will be for the railways in order to insure transportation of food. The claims of industry will come next, in order that credit may be created by the production of articles of commerce. Next, the mass of the people will receive coal for heating and cooking. It was com-

mented that the prospects for the latter class are exceedingly slim.

The German Minister of Economics, in the course of the recent debate on the coal situation, told the National Assembly of Germany that the government was ready to import American coal for industrial purposes, and he indicated that it might be necessary this coming fall to discontinue passenger traffic in order to use all available equipment to haul coal and move crops.

Countries Coerced Respecting Coal

It is not necessary to extend our survey into the coal conditions of the smaller European countries. Norway, Sweden, Denmark, Holland and Switzerland, though neutral during the war, found themselves practically dependent upon the warring nations for coal and had to submit to the dictation of terms upon which that necessity would be supplied them. Both Great Britain and Germany released coal to these countries in exchange for food. Germany supplied Holland with coal on condition that food, especially vegetables and meat raised on Dutch soil be sent to Germany; and you may recall that Germany's demand for supplying Switzerland with 200,000 tons of coal per month was gold at the rate of 40,000,000 francs monthly for nine months. Without touching further upon the stressful conditions in these smaller countries, the comments already made, especially respecting coal conditions in Great Britain, France, Italy and Germany, clearly prove the very serious conditions existent in European countries—and this, may I add, at a time when every effort is being made to re-establish mercantile and other conditions on bases approaching what they were prior to the war. Most assuredly this means keen competition for any available coal, and in this respect the governments and peoples of Europe are looking for a maximum of relief through coal shipments from the United States.

United States' export coal is a phase of the world coal problem in which Canada is deeply interested, because she yearly imports from 15,000,000 to 20,000,000 tons of coal—anthracite and bituminous—from the States.

Embargoes May be Necessary

Now, in the statement I am about to make I wish to emphasize that it is in no sense my intention to suggest that it is, or that it would become, the arbitrary desire of the United States to deprive Canada of the coal which at present is so necessary to life in this country. Of course with their co-operation, we have in a measure become dependent upon their coal fields, and it will be expected that the States, in all fairness, will facilitate any necessary future readjustment connected with Canada's fuel supply. It is important, however, to take cognizance of the fact that a nation, pressed by the demands of its own people, may be compelled, under certain conditions, to deprive other nations—in part at least—of even the necessaries of life until the needs of its own citizens are met. No country can be expected to send out of its own confines that which is essential to the very existence of its own people. Personally, I do not believe that the United States, or any other country with a large outlook on present world affairs, will allow whole nations, especially those with whom they have been allied, to suffer direst distress with respect to fuel without seeking to alleviate it to the greatest possible extent.

When communities in Canada and the States during previous coal shortages have been in need of coal, certain communities adjacent to other sources of supply, such as wood, softer grades of coal, etc., were compelled to use these in order that the supplies elsewhere available could be distributed to those in greatest need. Correspondingly, it would not be surprising if a country like Canada, with vast fuel resources, were directed to speed up its utilization of its own fuel, and would not be left undisturbed, so to speak, in its enjoyment of burning what is now one of the luxuries of the world, namely anthracite from the coal fields of Pennsylvania.

Let us next note what in general are the conditions in the great republic across our borders. Coal production in the United States has dropped substantially behind what it was during the war years. If the present rate of production of bituminous coal is maintained for the remaining twenty-one weeks of the coal year, the production will about equal the output of 1913. The production of anthracite is increasing over what it was a few weeks ago, but it is still short of the demand. The coal stocks of the United States have been depleted. There is great demand for transportation. Car shortage will accentuate itself with the demand for cars to move the grain crop. The exit of miners back to Europe, serious strikes, and other factors, have contributed to curtail coal production and distribution in that country. If more serious strikes should occur in the States, it will tend to make the supplying of coal to other countries, including Canada, still more precarious. Canada cannot afford to overlook how her own interests may at any time become involved by serious coal strikes in the United States. These strikes are an ever-present menace. Speaking in the United States Senate on August 8th, Senator King, of Utah, stated that he had heard "that there was a program to organize a great strike now, to tie up the transportation system and take over the railroads, then next winter, when the people were shivering for want of coal, organize another strike in the mines, cut off the country's fuel supply, and take over the mines." The senator expressed the hope—and which we all share—that government authority will be able to prevent such extremes being reached. I simply quote the senator's statement as indicating possibilities which he thought of sufficient importance to bring formally to the attention of his colleagues. It is clear, therefore, that coal production in the States must necessarily fall short of meeting even the most pressing demands.

Common Aims and Sympathies

Canada is indeed exceedingly fortunate in being neighbor to a country whose national aims and sympathies are so akin to its own. During the war both countries have manifested special interchange of courtesies. In the past coal shortage, for example, the Fuel Controller, Dr. H. A. Garfield, announced that recognition of Canada's needs for coal would be on the same basis as though she were one of the states of the Union. Our own Fuel Controller, C. A. Magrath, rendered signal service to both countries. I like to recall the sentiment manifested by our neighbors when great distress has arisen due to necessity corresponding to that begotten of the Halifax catastrophe—and such sentiment has been reciprocated by Canadians when conditions have been reversed. The governor of Massachusetts telegraphed assuringly, "The people of the Commonwealth of Massachusetts are ready to answer any call that may be made upon us. Massachusetts stands ready to go the limit in rendering every assistance you may be in need of." The Governor of Maine telegraphed, "Any help Maine can give is yours," while many others sent corresponding messages. These sentiments cannot better be summed up than in the inspiring message sent by President Wilson to

"His Excellency the Governor-General of Canada:

"In presence of the awful disaster at Halifax the people of the United States offer to their noble brethren of the Dominion their heart-felt sympathy and grief, as is fitting at this time, when to the ties of kinship and community of speech and of material interests are added the strong bonds of union in the common cause of devotion to the supreme duties of national existence."

Canada Must Bestir Herself

Obviously, so long as such sentiments govern men's actions, the people living on this continent cannot be deprived of that which is essential to their existence. Nevertheless, with the growing scarcity of coal, the United States, no matter what her good will or desire towards Canada may be, may not be able to cope with her own and with the prevailing world need. There is no doubt that in the spirit and disposition manifested in the statements just quoted our neighbor will see that Canada is fairly dealt with. We should not, however, trespass unduly upon friendly accommodation.

As we have now seen, the present need of coal is urgent and world-wide. If the United States, either in the interests of her own people or in the interests of the peoples whom she may conclude to be more needy than Canada, should decide that it is more necessary to supply such nations with coal, with the result that Canada's normal supply be substantially reduced, who may reasonably find fault with such a course? Even apart from governmental action, could anyone find fault with the United States coal merchants if, in their efforts to capture as much as possible of the 160,000,000 tons of annual international coal trade, they sought to deal where they could do so most advantageously? If, under such circumstances, Canada be judged to be not the best market for the United States coal dealer, from whence does Canada hope to supplement any substantial lack in supply of her coal demands? Let me emphasize the fact that there is nothing new in these possibilities so far as Canada is concerned. The handwriting on the wall has for years been legible. The whole problem has been one calling for ablest statesmanship and not for political or other temporizing and expediency. The problem will never yield to any makeshift policy. I have often marvelled that so little has actually been accomplished with respect to its permanent solution.

No Menace More Serious

It is gratifying to realize that serious effort is now being made towards the development of our lignite and peat resources; also, towards the increased utilization of our coal fields in the east and west. I understand that work preparatory to the construction of the carbonized lignite briquetting plant to be erected under the direction of the Honorary Advisory Council for Scientific and Industrial Research for the Dominion government is being pressed ahead with despatch. This is to have a capacity of 30,000 tons of briquettes per annum. It would take over 600 of such plants to replace our present coal importation from the States. However, we are very glad that this start has been made.

From the foregoing comments it is evident that an intelligent outlook upon world conditions shows scarcely any aspect of them to be of more serious moment—immediate or prospective—than this coal problem. During these warm days we should be careful to take our counsel and warnings from an intelligent outlook upon these conditions and what they betoken for the future, rather than from our feelings based upon the present state of the thermometer. Whether conditions of curtailed fuel supply for Canada be delayed from materializing this coming winter or next winter, or until some time in the future, nevertheless, as I stated before, I am firmly convinced that there is no menace to Canada's economic and general welfare at all comparable to the fact that she is at present so largely dependent upon a foreign country for her fuel needs. Without this foreign supply, Canada most assuredly would be put to desperate straits. Gentlemen, is not the fuel problem of this Dominion one of magnitude and great gravity?

Canada's Water-Power Heritage

Canada, it is true, is richly endowed with water-power, but she can never depend upon this asset as a sole source of heat. We have about 19,000,000 estimated 24-hour low-water horsepower, of which less than 2,500,000 h.p. has been developed. By no means may all the water-powers be economically developed.

For many years past I have been emphasizing the comparatively limited use which can be made of electric energy as a wholesale substitute for coal for heating—including the heating of buildings. There is no use whatever entertaining hope that hydro-electric energy as a heating agent may become an adequate substitute for coal for the citizens of Canada, and consequently a realization of this fact will facilitate the concentration of effort upon sources from which real relief may be derived.

What, then, is to be done? In a word, we must develop our own coal reserves. Considering the country as a whole, Canada in respect of quantity, quality and accessibility for mining purposes, possesses coal deposits which compare favorably with those of the greatest coal mining countries of the world. Speaking in round numbers, she has nearly 1,000,000,000 tons of semi-anthracite coal, 315,000,000,000 tons of bituminous coal, and 10,000,000,000.000 tons of sub-bituminous coal and lignite.

I shall not dwell on these enormous reserves. It seems out of place to emphasize how much we have latent when alongside of it we are not able to show how beneficially these assets are being used both for our own support and for the assistance of other needy nations. When the population of the prairie provinces are insured against yearly fuel shortage, we shall be more interested in hearing emphasis laid upon the enormous fuel reserves of these provinces; and when Canada produces more than her present amount of 2% of her total annual oil consumption we shall be more interested in hearing emphasis placed upon the statement that we have the biggest oil fields in the world.

Development Only Sane Policy

Canada's only sane policy is to develop, and that as rapidly as possible, both her own fuel and power resources, and by co-ordination of transportation and other cognate agencies to provide for the distribution and storage of fuel in all communities of the Dominion. In some respects it is more important to move coal and have it adequately stored and distributed throughout Canada than it is to remove the grain out of the country.

In this connection may I comment that we have heard so repeatedly about the necessity of laying in our coal supplies early that I have wondered why no provision has been made to aid that large proportion of the wage-earning population, who covet the ability to lay in their coal early, but who are unable to finance the proposition. The agriculturist is not only counseled to market his grain but governmental and financial agencies make exceptional provision by way of furnishing funds and credit to facilitate grain-marketing operations. Does it not seem as though some corresponding provision, with resulting insurance to the stability and advancement of the country, could be provided in connection with the laying in of the annual coal supply?

In concluding may I digress a moment, for there is one aspect of this fuel situation which I conceive to be of essential importance, and I feel it desirable just to mention it. In so doing I know you will not feel that I am seeking to impose upon you any view foreign to the main theme of our discussion.

Human Power Limited

A few years ago I attended an irrigation conference in western Canada. At that time great development was taking place in the irrigation areas, and in the enthusiasm of these circumstances the official program of the conference bore this motto: "Intelligent men no longer pray for rain—they pay for it." At the time I felt that this suggested an ill-advised spirit in which to undertake irrigation or any other work. Probably those who selected the motto did so somewhat unwittingly and did not stop to consider what it may imply. Man certainly could pay for the digging of the ditches and for the construction of other physical structures incident to irrigation development, but man does not own the water nor can he, by payment, command the rain to replenish it.

For a number of years my work in London took me past that busiest spot in the world—the Royal Exchange—and I used to observe upon its pediment the motto selected by Prince Albert from the Scriptures of Truth: "The Earth is the Lord's and the fulness thereof."

Now, what I wish here to suggest is that in any problem, especially in one of the magnitude and seriousness of the fuel problem of Canada, we cannot afford to deal with it solely on the basis that we, of ourselves, are alone sufficient best to solve it. The Creator has placed coal and other resources in the earth beneficently to serve the needs of man, who, of himself, has not the control over all essential factors germane to these resources nor the wisdom how best to dispose of them. If, for example, man could simply have paid for the rain or its equivalent, we may assume that we would not be experiencing the distressing conditions of dry-

ness which this season have existed over extensive areas upon which we have stimulated settlement in our northwest. Correspondingly, I wish to suggest that in the development of Canada's fuel resources for the need and general benefit of the people there certainly is required more wisdom than has hitherto been manifested in connection with this problem, and this wisdom, I believe, concurrently with our own efforts and in fitting humility, must be sought and received from the One to whom, as the motto just cited states, belongs "the earth and the fulness thereof."

Gentlemen, you operate in a great and unique field which comprises the effecting of economies by subjecting raw coal to such manufacturing processes as will save the valuable by-products and at the same time produce, even from inferior grades of coal, a satisfactory and clean-burning fuel. It is within your province also to aid in effecting a proper co-ordination of the uses of electricity, coal and gas, according to their respective spheres of most efficient use. This oftentimes will result in a greater utilization of gas. Those in the forefront of the gas-producing industries are justified in looking forward to the greatly increased use of this commodity, and to the fuller recovery of by-products. Your contribution to the solution of the national fuel problem of Canada is invaluable. Your field has an ever-extending horizon. I trust you will all find it a truly profitable one for the enthusiastic exercise of your talents.

RECENT PUBLICATIONS

GRIEVE GRATE.—Twenty-page booklet issued by the Combustion Engineering Corporation, New York, illustrating Grieve grates for hand-fired boilers.

ROAD MATERIALS NEAR REGINA, SASK.—By L. Reinecke, published as Memoir 107 of the Geological Survey, Ottawa; 26 pages, index, map and cover, 6½ by 9½ ins.

CIVIL SERVICE COMMISSION.—Tenth annual report of the Civil Service Commission of Canada for the year ended August 31st, 1918; 36 pages and cover, 6½ by 9¾ ins.

MACKENZIE RIVER BASIN.—Report written by Charles Camsell and Wyatt Malcolm and published by the Geological Survey, Ottawa; 154 pages, map and cover, 6½ by 9½ ins.

CEC TUBE SCRAPING DEVICE.—Twelve-page bulletin issued by the Combustion Engineering Corporation, New York, illustrating and describing boiler-tube scraping device.

GEOLOGY OF THE DISTURBED BELT OF SOUTHWESTERN ALBERTA.—Memoir 112 of the Geological Survey, Ottawa, by J. S. Stewart; 66 pages, index, maps and cover; 6½ by 9¾ ins.; illustrated.

D. L. S. ANNUAL REPORT.—Annual report of the 12th annual meeting of the Association of Dominion Land Surveyors, held last January in Ottawa; 182 pages and cover, 6 by 8½ ins., illustrated.

CHIMNEYS.—Loose-leaf catalogue published by the Rust Engineering Co., Pittsburgh, Pa., illustrating radial brick chimneys, tapered reinforced concrete chimneys, linings for steel stacks, flues, etc.

INVAR BASE LINE TAPES.—Publication No. 3 of the Geological Survey, Ottawa. Determination of lengths of Invar base line tapes from standard nickel bar No. 10,239; 26 pages and cover; 6½ by 9½ ins.

PROTECTING NEW YORK'S WATER SUPPLY.—Booklet published by Walace & Tiernan Co., Inc., of New York, 24 pages and cover, 7 by 10 ins., illustrating and describing liquid chlorine plant installed by New York City.

HAZELTON DISTRICT, B.C.—Memoir 110, Geological Survey, Ottawa. Preliminary report on the economic geology of the Hazelton District, B.C., by J. J. O'Neil; 48 pages, index maps and cover; 6½ by 9¾ ins.; illustrated.

ECONOMIC USE OF COAL FOR STEAM RAISING AND HOUSE HEATING.—By John Blizzard, technical engineer of fuel and fuel testing devices, Mines Branch, Department of Mines, Ottawa; 22 pages and cover, 6½ by 9¾ ins.

O. L. S. ANNUAL REPORT.—Annual report of the Association of Ontario Land Surveyors and proceedings of its 27th annual meeting; 192 pages and cover; 6 by 9 ins.; contains a list of registered Ontario land surveyors.

CLINTON FABRIC.—Booklet, 16 pages and paper cover, 6 by 9 ins., issued by the Pedlar People, Ltd., Oshawa, Ont., showing photographs of concrete pavements and sewers built with Clinton wire fabric. Printed in French and English.

MINING OPERATIONS IN QUEBEC.—Report on mining operations in the Province of Quebec for the year 1918, issued by the Department of Colonization, Mines and Fisheries, Quebec, Que.; 156 pages, index, maps and cover; 6¾ by 9½ ins.

POTASH RECOVERY AT CEMENT PLANTS.—By Dr. Alfred W. G. Wilson, special investigator for the War Trade Board. Published as bulletin No. 29 of the Mines Branch, Department of Mines, Ottawa; 40 pages and cover, 6½ by 9½ ins.; illustrated.

GLOSSARY OF AERONAUTICAL TERMS.—Prepared by the Technical Terms Committee of the Royal Aeronautical Society; edited for the council of the society by W. B. Faraday, secretary of the society; 106 pages and cover, 7 by 9½ ins.; price, 60c.

DEPARTMENT OF LABOR.—Report of the Department of Labor, Ottawa, for the fiscal year ended March 31st, 1918; 46 pages and cover, 6½ by 9¾ ins.; contains the reports of the director of coal operations and the registrar of boards of conciliation and investigation.

SUIT FOR INFRINGEMENT.—The Portable Machinery Co., of Passaic, N.J., manufacturers of the Scoop conveyor, have issued a circular claiming that another concern has marketed an imitation of the Scoop conveyor, and stating that a suit is now pending for infringement of rights.

MAGANESE BRONZE CASTINGS.—Catalogue issued by the American Maganese Bronze Co., of Holmesburg, Philadelphia, Pa.; 3¾ by 9 ins.; 24 pages; illustrated. Special reference is made to maganese bronze valve stems and maganese bronze runners for hydraulic turbines.

ELECTRICAL PRECIPITATION.—Circular 7,375 issued by the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., describing the recovery of valuable material from smokes and gases; 24 pages and cover; 8½ by 11 ins., printed in colors on coated paper and well illustrated.

MINERAL PRODUCTION OF CANADA.—Annual report for the calender year 1917, of the mineral production of Canada, by John McLeish, head of the division of mineral resources and statistics and acting-director of the Mines Branch, Department of Mines, Ottawa; 258 pages and cover, 6½ by 9½ ins.

CONSERVATION IN 1918.—Address delivered February, 1919, at the annual meeting of the Commission of Conservation by James White, assistant to the chairman of the Commission of Conservation of Canada; reprinted from the tenth annual report of the Commission; 88 pages and cover; 6½ by 9½ ins.

STANDARD APRON CONVEYERS.—Catalogue No. 258 issued by the Jeffrey Manufacturing Co., Columbus, Ohio, describing all standard apron conveyers both of steel and wood flights. This catalogue contains 75 pages and gives general dimensions and other important data of interest to prospective purchasers.

PERFORMANCE OF COLLIERY PLANTS.—Reprint of article on the performance of colliery steam boiler plants and the saving to be obtained by their reorganization, by D. Brownlie, published in "Engineering," London, Eng.; 16 pages, folded table and cover; 7¼ by 9¾ ins. Issued by Brownlie & Green, Ltd., Manchester, Eng.

CLASSIFICATION OF THE CIVIL SERVICE.—The King's Printer, Ottawa, has published the report of transmission to accompany the classification of the civil service of Canada by Arthur Young & Co. This forms a booklet of 82 pages and paper cover, 6½ by 9½ ins. The report states that "it describes schedules for the classification of positions and the standardization of compensation, explaining their need, basis, and the use and method of their preparation, and including a discussion of the problem of the personnel in the Civil Service of Canada, with recommendations for a comprehensive employment policy and plan."

ARCHITECTS MEET IN TORONTO

THE annual convention of the Ontario Association of Architects opens at 9 o'clock this morning at the Engineers' Club, Toronto. The first item on the program is a meeting of the council. At 10 a.m. the first business session starts. It will be followed at 1 p.m. by a luncheon at the King Edward Hotel. After the luncheon there will be a discussion on the viewpoint of the public in regard to the architectural profession.

At 3.30 p.m. a discussion of the legal status of technical professions will be opened by J. P. Hynes, architect, Toronto, and Harry G. Acres, hydraulic engineer of the Hydro-Electric Power Commission of Ontario, who is chairman of the joint committee on technical education. This subject will be followed by a discussion on the use of the term, "registered," in connection with Canadian architects, the discussion being introduced by Ralph Shepard.

At 7.30 p.m. the members of the Ontario Association of Architects and of the Royal Architectural Institute of Canada will visit the Royal Ontario Museum of Archæology as the guests of Prof. G. T. Currelly, director of the museum.

At 9 a.m. to-morrow, October 3rd, the council of the Royal Architectual Institute will meet, and at 9.50 a.m. the twelfth general annual assembly of the institute will be opened by an address by the president of the Ontario Association of Architects, with response by the president of the Royal Architectural Institute.

After routine business, there will be a discussion at 10.30 a.m. on architectural education, led by Prof, Ramsey Traquair, of Montreal, and W. D. Cromarty, of Ottawa. At 1 p.m. there will be a luncheon at the King Edward Hotel, with round-table discussions by Dr. H. J. Cody, Minister of Education; Sir Robert Falconer, president of the University of Toronto; and C. H. Mitchell, dean of the Faculty of Applied Science of the University of Toronto.

The luncheon and discussion will be followed at 3 p.m. by a motor drive around Toronto, and at 7.30 p.m. by a public meeting at the Art Museum, 26 Grange Road, Toronto, to view an architectural exhibition. There will be a popular address by Mrs. H. B. Dunnington-Grubb.

At 9 a.m., Saturday, October 4th, there will be a joint meeting of the Ontario Association of Architects and the Royal Architectural Institute of Canada, with an address on "Town Planning Acts and Their Results," by Nolan Cauchon and Thomas Adams; on "Housing," by W. D. Cromarty and James Govan; and on "War Memorials Considered Aesthetically," by Prof. P. E. Nobbs, of McGill University, Montreal, and Herbert E. Moore.

At 1 p.m., Saturday, there will be another luncheon and round-table discussion at the King Edward Hotel, and at 2 p.m. a meeting of the Ontario Association of Architects for the election of officers, followed at 3 p.m. by a meeting of the council of the Royal Architectural Institute of Canada for the same purpose.

The Royal Architectural Institute of Canada is a federation of the Architectural Institute of British Columbia, the Alberta Association of Architects, Saskatchewan Association of Architects, Manitoba Association of Architects, Ontario Association of Architects and the Province of Quebec Association of Architects. The honorary secretary is Alcide Chaussé, of Montreal.

RECONSTRUCTION OF SMALL WATER-POWER PLANTS*

BY RAY KINGSBURY HOLLAND
Consulting Engineer, Ann Arbor, Mich.

DEVELOPMENTS that may be classed as small water-power plants, with heads ranging from 8 to 20 ft. and with a contributary stream drainage area of 100 to 500 square miles are principally for flour and feed mills, but there are a large number of small hydro-electric developments, both private and municipal, and water works pumping plants driven by hydraulic turbines.

The owner, in looking over a water-power development that had been constructed prior to eight or ten years ago, generally feels, and correctly so, that the plant can be improved, but he is usually at a loss as to just how to go at it. He knows whether or not his present plant is sufficient in power to carry the usual load he imposes upon it, and he knows for what seasons of the year he is very short of water, and what seasons he has plenty of water, and approximately the range of head that prevails. He knows that the turbines are old and is aware that if he should purchase new wheels similar to those installed, he would undoubtedly receive more power; but when he makes an examination of the turbines, he finds that the replacement of perhaps a broken gate and a little lining up of the shafts will give him, in appearance, a turbine which looks as serviceable as a new one. The consequence of all this is that while he has a feeling that the plant ought to be reconstructed, he has not been satisfied that the reconstruction will show him a particular gain for his investment.

Engineer Must Study Conditions

If we, as engineers, could be called in to examine such a plant, with the idea of putting before the owner concretely what his needs are and what the costs will be, we find that we must start deeper in the problem if we will obtain for the owner any particular advantage in reconstruction. We must go back first to study his plant and check up as to whether the original installation was suited to the stream and the purposes to which he proposes using it.

The question of whether the machinery installed is suitable or not for the speed at which he desires to operate and for the prevailing head, we can pass up for the present until study of the other considerations influencing the development is completed.

The stream flow is naturally of the most importance to the development and its determination is usually our first consideration. The stream flow at a particular site may be determined by steam gaugings or observations of flow over a dam of uniform crest and the like, but to be of any value the observation must extend over a considerable period of time. It is generally the case that there are no records of the particular stream at the particular site being considered. The engineer must then draw upon his accumulation of stream flow data of other streams, in the neighborhood if possible, having similar drainage basin characteristics, in order to estimate the probable flow of this particular stream at the site considered.

Application of Known Data

The judgment used in the selection of the records of known streams and their applicability to this drainage area is an all important factor in this approximation of stream flow. It is to be particularly noted that three or four stream observations at this site, unless they be selected at extreme conditions and at average conditions, are of very little value in arriving at what might be the average flow of the stream in the course of a number of years.

Assuming that we have arrived now at the average flow of the stream, the next point to consider is the head under which the turbines will operate. The head, as we use it, is the distance from the average water surface level in the

*From paper presented to the Michigan Engineering Society.

wheel pits to the average surface level of the water in the draft pit; or in case a curved draft tube is used discharging the water down-stream, to the water surface at the exit of this draft tube.

Factors Influencing Head

The two particular factors, therefore, influencing the head are the level of the water surface of the pond and of the tail race. The pond level is subject to variation due to the stream flow being less, or in excess of that used by the turbines. The excess is taken care of usually by flood gates or spillway, and the pond is generally at its highest level during such periods. When the river flow is less than the water used by the turbine, there is a draft on the pond and the water is pulled down.

The highest stage that the pond may be carried is generally controlled by the flowage rights and in each case requires investigation as to whether there are physical limitations to a higher pond stage, that is to say, whether the raising of the pond level will cause very large flat areas to be flowed, or is prevented by the physical conditions at the dam or plant. If no such limitations are present, it is usually advantageous to the owner to acquire flowage for a higher pond level, and it can be usually shown that this flowage is worth much more to the owner than he has assumed it to be, when he has considered it worth only the value of the adjacent property for farming purposes.

The tail water level is generally the level of the natural river before the development, and if there are no obstructions immediately below the plant, usually no particular advantage to the head may be gained by improvement to the tail race, such as deepening and the like.

Effect of Raising Pond

There is one factor usually present in the question of raising the pond that is little understood, and that is the question of backwater, meaning by backwater, the increase of the water stage due to the construction of the dam, over the water stage of the natural stream. With any dam constructed across a stream and with a normal stream flow and the pond level carried at the crest of the spillway, the maximum backwater effect will occur at a point located approximately at the intersection of planes tangent to the water surface of the pond and to the water surface of the stream above the pond. If the pond surface is now maintained at the crest of the dam, with increasing stream flow, the backwater effect will usually become less and with decreasing flow becomes greater at this point, but if the spillway is of ample discharge capacity so that the head on the spillway for the overflow, increases at a lesser rate than the normal river stage for the same increased flow of water, the backwater effect at the point first considered becomes no greater with this increaseing flow, when such increase of flow is wasted over the spillway.

While it may be found that the amount of the backwater effect is less with the increased flow being wasted over the spillway, at the same time it may be also found that the backwater effect reaches further upstream. Usually this is of little importance because of the small amount of the increase of river stage, but should this back against another water-power development this small amount of backwater effect frequently causes a large amount of trouble.

The engineer should make a careful study and endeavor in such cases to clearly present the problem so that it may be understood by the interested parties and if possible form the basis of an agreement whereby the lower development may back water against the upper under the extreme conditions, thereby obtaining between the two plants the maximum power obtainable from the river.

Uses for Power

The use to which the power is to be put is our next consideration. If for milling or manufacturing, it is generally for 9 or 10 hours each working day, sometimes for the 24 hours. If for hydro-electric developments with a single plant, power may be required for 24 hours but sometimes is required for only 10 or 12 hours, this usually where commercial lighting only is served, or for lighting and pumping where a reservoir or elevated tank is available.

In reconstruction, this matter is more or less definitely settled by the past performance at the plant, and the gain in power output from the higher efficiency usually provides a margin that insures the turbine being of sufficient capacity to care for peak periods.

Where a change in the length of period of operation or additional load is contemplated, particular attention must be given to the probable power obtainable at the site in order to advise whether the development will permit the change.

The capacity of the pond (in acre feet) is the factor which determines the ratio of the maximum power of the daily period to the average 24-hour power available from the river flow.

An acre foot being the quantity in an acre of water 1 ft. deep, the capacity of the pond is then dependent upon the product of the average area and depth of draft to which the pond may be drawn. The area being fixed by physical conditions the capacity is directly dependent on the draft. But the draft on the pond reduces the head on the turbine and results in a power loss that increases at better than three halves power of the ratio of the change of head, consequently a minimum draft is desirable. From practical considerations 5 to 8% of the head may be permitted as the draft on the pond.

Pulling Down the Pond

This question of pulling down the pond is one that the engineer should cover thoroughly with the owners of the development, as the usual rule is to find that the operators of the plant pull the head excessively at the beginning of the summer season and it is not given an opportunity to recover again until the fall rains, resulting in shortage of power during the whole summer. We find this condition usual with municipally operated plants and only little less frequent with privately owned plants. One plant, a year or so ago, whose average head is 15 ft., pulled the pond in the first three summer weeks to between 9 and 10 ft. and operated at these low heads all summer by generating some auxiliary power by steam and cutting short the street lighting period. The plant capacity at these lower heads for the same amount of water was less than one-half the capacity at the full head, and had the auxiliary power been supplied when the head started lowering, auxiliary power would probably only have been required the first week of the summer period. Best rule is perhaps to have the pond brought to normal stage at least once in 24 hours.

The ratio of the turbine capacity to the normal stream flow is determined as is shown above from the considerations of the load to be carried and the size of the pond, and the permissible draft on the pond.

Deciding Capacity of Turbine

We have now gotten the elements together that permit our decision as to the capacity of the turbines to be installed. By reference to our determination of the river flow we can select the point from the expected average annual stream flow that will give us the most economy in the relation of the cost to the power obtained. Naturally, if the installation is made equal to the minimum continuous flow, we would obtain the most power for the least money invested in machinery only, but because of the investment in the powerhouse, dam, flowage rights, etc., we usually find that the economical development in most cases will occur at a point in the stream flow that may be said to just above the average normal flow of the stream. Applying to the quantity of water flowing, we can obtain the theoretical 24-hour power of the development, to which must be then applied the factor previously determined by the use to which the power is to be put, resulting in the theoretical capacity to be installed.

If this be taken roughly at 70% to 75% efficiency, the approximate plant capacity is obtained, which may be checked against the power required for the operations, and adjusted, if necessary, to meet the actual conditions that prevail. This adjustment however, is usually at a sacrifice of the power that the stream produces. This is true from the fact that if a much larger installation is made, the effici-

ency of operation is less because of the necessity of running at small gate openings for longer periods, and if a much smaller turbine is installed, the possibility of not being able to carry the peak load becomes pertinent.

Selection of Turbine

As is generally known, a turbine of a given runner characteristic will have a practically fixed speed for a given head for each of the manufacturer's size of turbines, and it is necessary here to make adjustments and concessions between the capacity of the wheel or wheels and speed at which these wheels are to operate. The higher the speed, of course, the smaller the individual turbine. With hydro-electric developments this problem is usually complicated further by the fixed speed requirements of an alternating current generator, and with any development it is usually necessary that the speed selected be maintained constant, notwithstanding the variations of head that will occur.

It is, therefore, necessary that the engineer, in making the selection of the turbine, be conversant with the type characteristics and the standard capacities of the manufacturers' developed turbines and co-ordinate the number of turbines and the speed to the total capacity which is now practically fixed, to obtain the maximum power under the variations of head and load usually prevailing.

Aside from the runner characteristic of the turbine to be selected, some consideration must be given to the mechanical construction of the turbine, so far as relates to the shop work, strength and rigidity. These being more important where the turbine is to be operated on an extremely variable load, with the gates controlled by oil pressure governors.

Having selected the turbine a computation of the probable annual output may be made, which combined with the fixed and operating cost forms a criterion from which the owner may arrive at a decision as to the necessity of reconstruction.

Details Affecting Operation

There are numerous minor details now to be considered relating principally to those affecting the operating of the plant.

If the power is to be used for milling and for general manufacturing purposes, the so-called friction governors are generally satisfactory, but if for hydro-electric work, it is usually necessary to have the more sensitive oil pressure governors. The question of bearings and the supporting of the runner and shaft is more important than the consideration usually given, because these points are the ones continually under the observation of the operator, and where no trouble is experienced, he has faith in his machinery and does all in his power to keep it in first class condition, while, if he is continually having trouble with alignment of shafts and with bearings, he is very apt to become convinced that the entire equipment is no good, with the result that he does not give it the attention that it should have to deliver the power of which it is capable. This is a point that is frequently lost sight of, and is particularly important one from the owner's point of view.

The structure to house the equipment is controlled primarily by space required for the machinery on the operating floor and by the requirement of ample water passages to and from the turbine, and secondarily, by the relation of the structure to existing structures, bridges, the channel, and the like.

The power-house construction itself does not differ materially from other first class constructions except the requirement of water tightness, rigidity of construction and the necessity of providing that no settlement takes place. Special caution must be observed, however, that foundations are protected against undermining, as a small spurt of water at a critical point will very quickly wreck the best hydraulic structure.

The shape of the flume and location of the turbine in the flume requires special study, if for any reason that water area to the turbine is to be restricted. Trash racks and easily operated wheel pit gates are necessities to a well designed plant, particularly the desirability of easy and quick operation of the head gates by the operator, as they serve as an inducement to him to the making of periodical inspections of the turbines and under-water mechanisms.

Unless the head is very low the turbine is invariably placed above the tail water level, making the question of the draft tube a particularly important one, and not of easy solution even when the engineer has wide lattitude in his design. When space is restricted, the design of the draft tube must be governed largely by the designer's experience and the results obtained from other constructions where conditions analogous to those under consideration are present.

Examples of Plant Reconstruction

As a result of the practical application of the principle of making a study of the small plant reconstruction along lines very similar to those followed with a larger installation, I would cite the following reconstructions of this type made by our firm in the last couple of years:—

In a hydro-electric plant in the northern part of Michigan, drainage area about 100 square miles, normal head about 14 ft., the old installation was a single turbine some 20 years old, rated at 170 h.p. apparently in good shape except that the runner had the edges of the buckets bent by debris going through the gates. The turbine was gear-connected to a line-shaft some 15 ft. long, running at about twice the speed of the turbine, from which a 150 k.w. generator was belt-driven. The plant operated only on night load. This equipment was replaced by a single directly connected turbine and generator unit of 100 k.w. capacity, the rating of the turbine being slightly smaller than the original turbine and running at about 60% greater speed. The plant is carrying from two to four times the load previously carried, and at no time within the last two years has the plant been short of water, as had been the case each mid-summer and wid-winter season previous.

A hydro-electric plant in the central part of Michigan, drainage area 500 square miles, 14 ft. head, formerly consisted of two turbines, each one gear-connected to two short horizonal line-shafts from each of which was driven a generator. There were two outgoing feeders from the plant and the load of both feeders was sometimes carried on the larger of the two generators, and at other times the units ran separately, one to each feeder. The reconstruction here was caused by the undermining of the foundation resulting in a collapse of the power-house. The equipment of the new power-house was in two units, each consisting of a directly connected turbine and generator, the one unit being approximately one-half the capacity of the other, permitting power to be produced at high efficiency from about one-sixth to full capacity of the plant. The load on the plant has been approximately tripled since the old plant went out of service and no shortage of water has been experienced within the last two years of operation.

Increases in Power Output

A hydro-electric plant consisting of two turbines, gear-connected to a horizontal shaft about 20 ft. long, to the end of which was directly connected a horizontal shaft, slow speed generator of 350 k.w. capacity, and to which was also belted a steam engine. One turbine, the gears and part of the horizontal shaft were removed, and a vertical shaft, directly connected generator unit installed with a turbine capacity slightly larger than one of the original turbine. Upon completion of the work the load was thrown from the remaining gear-driven unit, to the new unit and 100% additional load thrown on, and after shutting down the old unit the surface of the water in the tail race dropped about 4 ins. due to the decreased discharge through the new turbine, even when carrying double load of the old one.

In an industrial plant requiring power 9 hours, three old turbines were removed and replaced by one vertical shaft turbine, gear-connected to a mill, with the turbine selected for proper speed for connection to a future alternating current, vertical shaft generator. The new unit, although slightly larger than larger turbine of the old installation, is carrying, at about two-thirds capacity, the entire mill equipment, which has been materially increased over the installation which the old turbines could just carry.

PRESSURES IN PENSTOCKS CAUSED BY THE GRADUAL CLOSURE OF TURBINE GATES*

By Minton M. Warren
Engineering Department, Stone & Webster Engineering Corporation, Boston, Mass.

MR. GIBSON'S paper goes into the mathematical theory of ordinary water hammer more thoroughly than any previous discussion of the question, and is certainly a valuable addition to the literature on this subject. The curves presented by the author show the differences in the various formulas with great clearness.

The writer, however, does not believe that Mr. Gibson's method and formulas are practical for ordinary use for three reasons:—

First.—In order to use the formula, a large amount of very tedious figuring must be done, and unless it is very carefully checked by logarithms, a very small arithmetical mistake may make a large error in the result.

Second.—The formulas have not been confirmed by experiments and are based on certain assumptions the accuracy of which are open to question.

Third.—In most cases, simpler formulas will give as accurate results as the data warrant.

It is almost impossible to get away from the idea that the more calculations and exact mathematical methods used in obtaining a result in engineering, the more accurate the result will be, regardless of the assumptions on which the calculation is based. It is the same false accuracy that leads engineers to submit cost estimates figured down to odd cents on projects running into millions.

The writer does not believe that the many assumptions needed in deducing any formula for slow-closing gates warrant the elaborate methods used by Mr. Gibson, until these methods and formulas are backed up by careful and extensive experimental data, as were the formulas of Professor Joukovsky.

In arriving at his results, Mr. Gibson assumes that the area of the gate is closed at a uniform rate, whereas the writer, in deducing his simple formula, $h = LV/g(T-L/a)$, assumed that the gate moved in such a way as to cause the pressure to rise at a constant rate. In any given case, neither assumption is strictly true, and experiment alone will show which is nearer the average gate motion.

Referring to Fig. 9†, it is seen that, according to the author's calculations, such a gate motion, giving a constant rise of pressure, is not far from a straight line, and probably as near the truth in ordinary gates as his assumption (uniform reduction of area), which makes the mathematics very much more difficult.

There is great need for a series of careful experiments on slow-closing gates, and it is to be hoped that Mr. Gibson, or some other engineer, will undertake this work. Data from such tests properly used would be of more service to the profession than the most perfect theoretical formulas which have never been tested. Until this is done, engineers will have to base design on the meagre practical data available, guiding their judgment by unproved formulas, and the writer has found that the simple formula given above comes nearer the pressures he has observed in practice than other formulas, although, like the others, it is based on certain assumptions which are not strictly true.

In one point, Mr. Gibson's formula gives what appears to the writer unreasonable results. This is illustrated in Fig. 4§, where the curve rises very sharply between heads of from 10 to 100 ft. Alliévi's curve rises even more sharply and can be easily proved wrong, as it reaches values of h which are far above the maximum value possibly reached in instantaneous closing.

Mr. Gibson's curve stops at that value, but the writer does not believe that experiments confirm the large increase in water hammer for low heads over that for high heads. His assumption that the waves are perfectly reflected from the slowly closing gate is also open to question, and was not proved in Joukovsky's experiments.

It is not intended to imply that Mr. Gibson's formulas may not prove to be as accurate or even more accurate than the others, but, in the absence of any experimental proof, their added complexity does not seem to be warranted, in view of the approximations and assumptions on which they are based.

*Discussion (presented to the American Society of Civil Engineers) of Norman R. Gibson's paper (see September 4th and 11th issues of *The Canadian Engineer*).

†See *The Canadian Engineer*, September 11th issue, page 298.

§See *The Canadian Engineer*, September 11th issue, page 296.

ASSOCIATION OF C. B. & C. I. NEWS NOTES

AT the National Industrial Conference, the Association of Canadian Building and Construction Industries was represented by J. P. Anglin (Montreal), Fred Armstrong (Toronto), E. R. Reid (St. John), G. H. Whitlock (Moose Jaw), and Col. J. A. Little (Port Arthur); also by A. H. Dancy (Toronto), who substituted for H. T. Hazelton (Winnipeg). While on the way to the conference, Mr. Hazelton was taken suddenly ill, had to go to the hospital in Fort William, and later returned to his home in Winnipeg.

Mr. Armstrong was appointed a member of the committee dealing with the question of the eight-hour day, and Mr. Anglin was elected chairman of the committee dealing with the question of collective bargaining and the recognition of labor unions.

During the conference a number of the Montreal and Ottawa members of the national council met with the delegates at dinner and afterwards held an informal council meeting. J. C. Frazee, secretary of the National Federation of the United States, was present and gave an interesting address on the history and methods of his organization.

It was decided to hold the next general conference in Ottawa commencing the last week of January, 1920, general sessions to commence Tuesday, January 27th. All contractors and builders and supply men throughout Canada are invited to reserve these dates and attend.

It was also decided, at the request of the western delegates, to have a convention in the west about the end of next month or the first week in December. A number of eastern men are planning to make the trip.

Arrangements have been prefected by the Dominion Bridge Co., Ltd., Montreal, for the manufacture of machinery for the pulp and paper trade. The company intends to contract for entire plants for the manufacture of newprint. It has submitted a tender, amounting to approximately a million dollars, to one of the large paper companies in Canada to supply the latter with complete equipment and machinery for the manufacture of newsprint.

At a meeting of the Chamber of Commerce of Brantford, Ont., held last week, a resolution was adopted protesting against the decision of the provincial department of highways to lay water-bound macadam on the provincial highway between Hamilton and Brantford, and urging that a more permanent type of construction be adopted in view of the fact that the Theodore Roosevelt International Highway will be routed by that road, thus assuring a continuous and heavy traffic.

The following resolution has been drafted for presentation to the Board of Directors of the American Association of Engineers at its October meeting: "Resolved that the Board of Directors of the American Association of Engineers call a conference of representatives of all organizations or societies of engineers, architects and similarly educated or experienced technical men, for the purpose of strengthening the position of engineers and technical men as a group distinct from labor and from capital but essential to both and to society in general, because of the fact that stability of the social structure resting on the tripod of labor, capital and engineering, is dependent upon the strength of this third support."

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THE NATIONAL INDUSTRIAL CONFERENCE

DISTINCTIVE among the features of the National Industrial Conference held last week was the ready agreement as to the benefits to be derived from uniformity in labor legislation, and from industrial councils at the meetings of which questions arising in any plant or in any industry could be discussed. Curiously enough, these both concern the form rather than the substance of labor adjustments, for in the case of legislation the conference did not commit itself as to what legislation should be adopted, but suggested that this should be investigated by a commission, which would use existing labor legislation as its material.

On the subject of hours of labor, most of the employers' representatives were convinced that the eight-hour day would reduce production. The labor delegates did not debate this issue, but on the other hand would not compromise it, preferring to stand by the eight-hour day as part of the program of organized labor throughout the world. The third group, as represented in the committee on the eight-hour day, passed a somewhat colorless resolution urging that it should be confirmed by legislation in those industries in which it had already been adopted. On this question, one of the principle subjects of debate at the present time, there was therefore no appreciable progress made.

Regarding the recognition of union, however, practically all employer delegates expressed themselves as not being opposed to organization, provided the employee was not forced to join the union. In reply to a question on this point, Tom Moore, president of the Trades and Labor Congress, stated that the recognition of a union did not imply the closed shop, unless this was specified in the particular agreement. There seems in fact to be no general objection to the organization of labor, provided that every employee is at full liberty to use his own discretion, and that employers are not forced to deal with organizations which extend beyond their own industry, and which can tie it up in spite of the fact that there is no disagreement at the time.

BARE vs. WEATHERPROOF WIRES

IN reply to a circular sent to central stations throughout Canada, A. A. Dion, of Ottawa, chairman of the Canadian Electrical Association's committee on overhead lines, received the following letter from one of the companies:—

"Re bare wire for line use under 2,200 volts. It has never been the practice of this company to use bare wire for city distribution and although it is generally understood that the insulation on the wire, especially after it has been baked out, is no adequate protection for 2,200 volts, it is useful in the erection of the lines so as to avoid mechanical injury and also from coming in contact with live lines already placed.

"Our company's rules provide that all lines are normally considered alive by our men and work done accordingly. Lines are only treated as dead when known to have been killed properly and the proper clearances given. In order to show differentiation between primary and secondary lines, lines of 2,000 and 4,000 volts are erected on porcelain insulators, while low voltage lines are on glass insulators.

"Use of both bare and weatherproof wire would necessitate carrying two classes of wire in stock as well as on repair and construction wagons. In city work the primary is only a small part of the distribution system and it would be still necessary to supply insulated weatherproof wire for all service work.

"In outlying districts where primary runs are long and service connections few, it would likely be considerably more feasible to use the bare wire."

Mr. Dion states as his own opinion that while ordinary weatherproof triple-braided insulation is not altogether effective, and linemen should treat all wires as alive, still the insulation is some measure of protection in dry weather and he favors its use on city streets.

ENGINEERING INSTITUTE ELECTIONS

AT a meeting of the council of the Engineering Institute of Canada, held September 23rd, 1919, in Montreal, the following elections and transfers were announced:—

Members.—W. H. Boyd, Ottawa; C. A. K. Cornwall, Victoria; David Kyle, Sault Ste. Marie.

Associate members.—H. W. Ault, Ottawa; H. E. Balfour, Quebec; J. A. Beauchemin, Ottawa; V. S. Chestnut, East St. John, N.B.; H. W. Frith, Vancouver; H. P. Fuller, St. James, Man.; L. E. Habben, Shawinigan Falls; D. W. Hodson, Nelson, B.C.; D. W. Jamieson, Ottawa; W. C. Macdonald, Woodman's Point, N.B.; J. G. MacLachlan, Kamloops; T. V. McCarthy, Toronto; J. C. McDougall, Montreal; J. F. O'Connor, Aylmer East, Que.; S. R. Parker, Regina; F. M. Perry, Sault Ste. Marie; Maurice Polet, Edmonton; C. H. Pozer, Vancouver; H. W. Racey, Westmount, Que,; A. S. Runciman, Montreal; H. B. Sherman, Regina; Sigmund Wang, Hawkesbury, Ont.; K. E. Whitman, Halifax; W. A. Winfield, Halifax; W. I. Young, St. John, N.B.

Juniors.—A. L. Bishop, St. Catharines; W. E. Plummer, St. Catharines.

Transferred associate members to members.—A. R. Archer, Port Washington, N.Y.; J. T. Farmer, Montreal; J. P. Hodgson, Vancouver.

Transferred, juniors to associate members.—J. G. Caron, Montreal; G. H. Kohl, Hamilton.

Transferred, students to associate members.—R. G. Bangs, St. Catharines; A. K. Hay, Ottawa, C. F. Szammers, Toronto; F. W. Taylor-Bailey, St. John, N.B.

Transferred, students to juniors.—Ralph Allingham, Grenville, Que.; G. H. Chalmers, Turbine, Ont.; C. H. R. Fuller, Toronto; E. C. Little, St. Catharines; J. E. Pringle, Hamilton.

Transferred, junior to associate member.—W. H. Norrish, Ottawa.

PERSONALS

WILLIAM STORRIE, who recently resigned as chief engineer and director of the John ver Mehr Engineering Co., Ltd., Toronto, in order to enter private practice, was born October 4th, 1883, in Paisley, Scotland. Mr. Storrie was educated at the Grammar School and Technical College at Paisley, and subsequently at the Glasgow and West of Scotland Technical College. He became an articled pupil to James Lee, city engineer of Paisley, and from 1899 to 1907, was engaged chiefly on water works construction. In 1902, he won the Brough scholarship and in 1905 the Glasgow Building Trades Exchange prize. In 1907, Mr. Storrie was appointed chief assistant to Crouch & Hogg and was engaged with them for the following two years on water works, bridge, canal and harbor construction. In 1909 he came to Canada and was appointed resident engineer on the construction of the slow sand filtration plant for the city of Toronto. In 1912, during the second typhoid epidemic in Ottawa, Ont., Mr. Storrie was appointed in charge of the water works of that city. A year later Mr. ver Mehr induced him to become chief engineer of the John ver Mehr Engineering Co., Ltd., in charge (jointly with Mr. Gore) of the design and construction of the drifting sand mechanical filtration plant at Toronto. During the past few years, in collaboration with Mr. Gore, Mr. Storrie also designed and constructed small filtration units for the Collingwood fisheries, the Dominion Bank building at Toronto, and the Sun Life building at Montreal. He and Mr. Gore also designed and recently completed a filtration plant of 1,728,000 Imperial gallons daily capacity for the town of Oshawa, Ont., and an effluent disposal works for the Robson tanneries at Oshawa, and also designed a small filtration plant for Rockland, Ont. Early in 1918, Mr. Storrie went to England to take charge of the construction of several reinforced concrete ships of 1,000-ton capacity, returning again to Canada in July last. Mr. Storrie is an associate member of the Institution of Civil Engineers of Great Britain and a member of the Engineering Institute of Canada. He is also a member of the American Water Works Association.

J. P. HARVEY has resumed his duties as town engineer of Vermilion, Alta., after having been overseas since August, 1914.

W. C. MILLER, assistant city engineer of St. Thomas, Ont., has been appointed city engineer, succeeding M. Ferguson, who recently resigned.

K. S. MACDONNELL, who returned from overseas two weeks ago, has resumed his work as town engineer of Barrie, Ont. Capt. Macdonnell was in the army for four years and seven months, serving twenty-seven months in France. After the armistice he was in charge of the prison camp at Abbeville, France.

D. H. WEIR has been appointed to a position on the teaching staff of the Technical School at London, Ont. Mr. Weir is a graduate of the University of Toronto, Faculty of Applied Science and Engineering, and was formerly assistant to the engineer of the counties of Dundas and Stormont, Ont. He was with the First Canadian Engineers for three years and was later appointed educational officer in connection with the Khaki University, with the first division.

PAUL E. MERCIER, consulting engineer to the Public Works Department of the city of Montreal, who recently tendered his resignation, may not leave the service of the city after all, as a new proposal has been made to him by the city commissioners and Mr. Mercier has taken it under consideration. He intends, however, to join the staff of L'Ecole Polytechnique as a professor in engineering, so even if he retains his connection with the city as consulting engineer, he will not be able to devote his whole time to the municipal work.

ROBERT B. MURDOCK, who has recently returned from military service in France, has been appointed executive engineer with the Asphalt Association of New York and Toronto. He will directly assist the secretary of the association in developing the organization and operating policy. Capt. Murdock has had an extensive experience in practical highway work, during the course of which, as resident engineer, he had charge of the construction of one of the most difficult portions of the Columbia river highway, including the famous figure "8" section at Crown Point, near Portland, Ore. Later he was appointed assistant state highway engineer of Oregon and held that office until he enlisted.

WALTER E. ROSENGARTEN has resigned as highway engineer in the United States Bureau of Public Roads, to accept the position of traffic engineer with the Asphalt Association of New York and Toronto. He will deal with the co-ordination of the design of the various highway types with the requirements of modern traffic. Since his graduation from the engineering department of the University of Pennsylvania, Mr. Rosengarten has had a combination of practical highway construction experience and research study with both the University of Pennsylvania and the U. S. Bureau of Public Roads. He was with the federal bureau about eight years, during which he spent about four years in practical highway construction, and about two and a half years in the research and testing division in connection with laboratory and field work.

OBITUARY

WM. DALE HARRIS, formerly well-known as a civil engineer, died last Sunday at his home, 263 McLaren St., Ottawa, Ont. Mr. Harris was born in England, but came to Canada at the age of twelve, graduating in 1872 with the degree of B.Sc. at the Massachusetts Institute of Technology. He was engaged upon the construction of the Brookline, Mass., water works, and later surveyed and assisted in the construction of the Intercolonial Railway, Nova Scotia Railway, Montreal and Western Railway and Gatineau Valley Railway. After having served five years as president of the Montreal Terminal Railway, he retired in 1901, although for the following few years he engaged in a certain amount of private practice.

Gore, Nasmith & Storrie, consulting engineers, have obtained offices at 409 Confederation Life Building, Toronto. This firm was recently organized with the intention of specializing in public health engineering.

The Public Utilities Commission of Manitoba has granted permission to the city of Brandon to increase its water rates by 20%. At a consultation between the commission and members of the city council, it was pointed out by Geo. L. Guy, engineer of the commission, that the city is losing considerable money on the water works, and that he would support the application for increase in rates. Mr. Guy also stated that there is considerable leakage in the Brandon water works system. It is understood that the increase in rates is to relieve the city temporarily, in a financial way, pending the completion of an exhaustive survey of the entire system.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand or proposed, contracts awarded, changes in staffs, etc.

BRIDGES, ROADS AND STREETS

Brantford, Ont.—City council contemplates construction of a bridge. T. H. Jones, city engineer.

Battleford, Sask.—The highway department, province of Saskatchewan, will soon award contract for improvement of road between Battleford and North Battleford. Length, 8,000 lin. ft. Fill required, 2,500 cu. yds. clay, and 2,000 cu. yds. gravel. H. S. Carpenter, deputy minister, Regina, Sask.

Brockville, Ont.—The Dominion government is constructing a new timber bridge on concrete piers over the Rideau River at Sly's Rapids.

East Kildonan, Man.—Contracts will soon be awarded by council, for construction of concrete sidewalks on Ottawa Ave. H. Thompson, secretary-treasurer.

Ford City, Ont.—Council will construct Silex walks on Ottawa St. n. side, Strabane to end of Ottawa St. and on Sandwich St., s.s., from lot No. 106 easterly to lot No. 3. J. E. Foster, clerk.

Galt, Ont.—Council will construct bituminous macadam pavement, with concrete curbs and gutter, on Queen St. W., from G.T. Ry. to Blair Rd. Estimated cost, $4,679. Asphaltic concrete pavement, with concrete curbs and gutter, on Queen St. W., from w.s. of West Main St. to the G.T. Ry. Estimated cost, $3,833. J. McCartney, clerk.

Gananoque, Ont.—Tenders will be received until 12 o'clock noon, October 14th, by the Ontario department of highways for construction of concrete structures on the provincial highway, in the township of Pittsburgh. Plans, etc., office of resident engineer, Gananoque; city engineer, Kingston, and at the department in Toronto. W. A. McLean, deputy minister.

Hespeler, Ont.—By-law has been passed by town council providing for expropriation of land on the Goebel estate to widen the corner of Guelph and Queen St.

London, Ont.—The London and Port Stanley Railway Commission will repair bridge over the Kettle creek, $11,000; construct a coal-ferry slip at Port Stanley, $8,500; erect loading platforms and shelters along the road, $6,500; overhead bridge repairs at Mohawk St., St. Thomas, $5,700; additions to sidings and double tracking line in St. Thomas, $25,000; additional electric locomotives and rolling stock. Total estimated expenditure, $370,000. Immediate expenditure necessary, $200,000. J. E. Richards, manager of radial. Sir Adam Beck, chairman of commission.

Niagara Falls, Ont.—City council will shortly call for tenders for construction of asphalt pavement with Willite process on Palmer Ave., between Benson and Victoria Ave Estimated cost, $42,353; and on Kitchener St., between Victoria and Powell Ave. Estimated cost, $17,744.85. W. J Seymour, city clerk.

North Vancouver, B.C.—The department of public works, Victoria, B.C., will soon demolish the Moodyville trestle bridge. A. E. Foreman, engineer.

North Vancouver, B.C.—The district council has decided to proceed with necessary repairs to the Capilano Marine Drive bridge. Estimated cost, $1,500. Engineer Cosgrove.

Pembroke, Ont.—Town council contemplates widening stone bridge on Pembroke St., and construction of 6 ft. sidewalks. A. J. Fortier, town clerk.

Peterborough, Ont.—City council has decided to open Cambridge St., north of McDonnel St., and to widen McDonnel St., west of the bridge over the creek.

Peterborough, Ont.—Council has decided to construct asphaltic concrete pavement on George St., from the C.P. Ry. to Romaine St., early next year.

Pickering, Ont.—Contract has been awarded by the Ontario department of highways for construction of the superstructure of bridge to J. McGinnity, Pickering. W. A. McLean, deputy minister.

Port Credit, Ont.—The Hamilton Highway Commission contemplate construction of an additional bridge over an arm of the Credit River, 200 yds. from the present bridge.

Prescott, Ont.—Tenders will be received by the highway department, province of Ontario, until noon, October 6th, for supplying field stone in piles along the provincial highway, from Prescott to Cornwall. W. A. McLean, deputy minister.

Sandwich, Ont.—Town council has ordered starting of construction of paving on Prince Rd., to be completed before October 23rd.

St. Jean, Que.—City council will soon commence construction of sidewalks for which tenders were called to be in by September 29th. H. Morais, secretary-treasurer.

Ste. Anne-de-Chicoutimi, P.Q.—Contract for the construction of the St. Maurice Rd. has been awarded to D. De Santis, 3180 St. Lawrence Blvd., Montreal.

St. John, N.B.—The city council has received the following recommended program of road construction to cover a period of four years: Douglas Ave., asphalt, granite blocks on concrete base in car tracks, $163,380; City Rd., Pond St. to Marsh Bridge, granite blocks, $134,740; Haymarket Sq., west side, asphalt, $6,058; Haymarket Sq., south side, from Brussels St. to Marsh Bridge, asphalt, $25,649; Marsh Rd., from bridge to city limits, asphalt, $109,890; Brussels St., asphalt, $86,175; Prince William St., from Princess to St. James St., asphalt, $41,011; Market Sq., asphalt and granite blocks, $36,212; St. James St., from Prince William to Wentworth St., asphalt, $57,151; Britain St., from Reed's Pt. to Charlotte St., granite blocks, $30,552; Waterloo St., from Union to Golding St., asphalt, $37,880. Estimated total cost, $728,698. G. N. Hatfield, city engineer.

St. Thomas, Ont.—One tender was received for construction of pavement on Hemlock St. Contractor, W. Irwin, for water-bound macadam, $2,875.60. Contract was not awarded, as council preferred, upon recommendation of W. C. Miller, city engineer, to construct an asphaltic macadam pavement on this street. New tenders will probably be called in a short time for this type of construction.

Toronto, Ont.—Board of control will call tenders for construction of pavement on St. Clair Ave. from the end of the existing pavement to Keele St.

Toronto, Ont.—Department of works contemplates repairs to subway under the C.P. Ry. at Runnymede Rd. R C. Harris, commissioner.

Toronto, Ont.—The city department of works has commenced filling the ravine on Gerrard St., east of Leslie St. Earth for this fill is being hauled from the east side of Coxwell Ave., by the city narrow-gauge construction railway.

Toronto, Ont.—Additional tenders received by the Board of Control for construction of pavements, contracts for which have been awarded, and details of which appear on the next page, were as follows: From the Godson Contracting Co., Ltd., asphalt, Annette St., Keele to High Park Ave., $15,894; Annette St., High Park Ave. to Fairview Ave., $28,138; Kenilworth Ave., Queen St. to 200 ft. n., $3,165; Middleton St., Sheridan to Brock Ave., $4,046. From Constructing and Paving Co., Ltd., asphalt, Fernwood Park Ave., Fir to Hazel Ave., $4,028; Fernwood Park Ave., Fir to 306 ft. s.,

$3,994; Front St., Spadina to John St., $26,876; Kenilworth Ave., Queen St. to 200 ft. n., $3,221; Kenilworth Ave., 200 ft. n. of Queen St. to 1,228 ft. s. of Kingston Rd., $15,575; Logan Ave., G.T. Ry. to Gerrard St., $9,685; McLean Ave., Queen St. to s. end, $17,140. From the Department of works, asphalt, Annette St., Keele to High Park Ave., $16,216; Annette St., High Park Ave. to Fairview Ave., $28,844; Fernwood Park Ave., from Fir to Hazel Ave., $3,959; Fernwood Park Ave., Fir to 306 ft. s., $4,064; Front St., Spadina to John St., $26,865; Kenilworth Ave., 200 ft. n. of Queen St. to 1,228 ft. s. Kingston Rd., $15,601; Logan Ave., G.T. Ry. to Gerrard St., $9,500; Middleton Ave., Sheridan to Brock Ave., $4,048; McLean Ave., Queen St. to s. end, $17,081. Brick block pavement on Waverley Rd., from Godson Contracting Co., Ltd., $19,844; and Department of Works, $21,146. R. C. Harris, commissioner of works.

Toronto, Ont.—Contracts have been awarded by the Board of Control for construction of pavements on the following streets: Bitulithic on Northcliffe Blvd., from Regal Rd. to St. Clair Ave.; Rosemount Ave., from Glenholme Ave. to Northcliffe Blvd.; Springmount Ave., from Oakwood Ave to n. limit, lot No. 30, plan M-312, to the Warren Bituminous Paving Co., Ltd., Toronto. Brick block pavement on Waverley Rd., from 1,300 ft. n. of Queen St. to Kingston Rd., to Asphaltic Concrete Co., Ltd., $19,824. Rejected tenders, Godson Contracting Co., Ltd., $19,844; Department of Works, $21,146. Concrete pavements on Belsize Dr., Yonge St. to Mt. Pleasant Rd., $16,044; Manor Rd., Yonge St. to Oswald Cres., $7,378; Sheldrake Ave., w.s.l., Sheldrake Blvd. to Beulah St., $5,583; Sheldrake Blvd., Yonge St. to Sheldrake Ave., $12,934, to the Department of Works. No other tenders were received. Asphalt pavements to Constructing and Paving Co., Ltd., Annette St., Keele St. to High Park Ave., $15,648; Annette St., High Park Ave. to Fairview Ave., $27,670; Middleton St., Sheridan Ave. to Brock Ave., $4,004. Asphalt pavement to Godson Contracting Co., Ltd., Fernwood Park Ave., Fir Ave. to Hazel Ave., $3,937; Fernwood Park Ave., Fir Ave. to 306 ft. s., $3,912; Front St., John St. to Spadina Ave., $25,877; Kenilworth Ave., 200 ft. w. of Queen St. to 1,228 ft. s. of Kingston Rd., $15,213; Logan Ave., G.T. Ry. to Gerrard St., $9,438; McLean Ave., Queen St. to s. end, $16,796. Asphalt pavements to the Department of Works, Kenilworth Ave., from Queen St. to 200 ft. n., $3,157. Concrete curbing to Godson Contracting Co., Ltd., Front St., n.s., John St. to Spadina Ave., 80c. per lin. ft. Concrete curbing to Constructing and Paving Co., Ltd., Annette St., s.s., Keele St. to Aziel St., 73c. per lin. ft.; Middleton St., n.s., Sheridan Ave. to Brock Ave., 73c. per lin. ft. Concrete curbing to Asphaltic Concrete Co., Ltd., Waverley Rd., w.s., 165 ft. 8 in., and e.s., 171 ft., 80c. per lin. ft. R. C. Harris, commissioner of works.

Vancouver, B.C.—Council has requested estimates for sidewalk on Bellevue at Twenty-Seventh St., and for opening a new roadway on King St. off Twenty-Third St. This new roadway is necessary in connection with construction of factory about to be undertaken by W. H. Todd and C. G. Barrow. Engineer Bell.

Walkerville, Ont.—Town council will construct concrete pavement on Dacotah and Oneida Sts. A. C. Cock, clerk.

Windsor, Ont.—City engineer will start construction of pavement on London St., Ouellette Ave. to Windsor Ave., immediately. Time of completion, October 23rd. E. Brian, city engineer.

Winnipeg, Man.—The repairs to the Redwood bridge will be completed and the bridge opened for traffic within three weeks. W. P. Brereton, city engineer.

Winnipeg, Man.—By-law will be prepared providing for construction of a new bridge on Maryland St. Estimated cost, $500,000. W. P. Brereton, city engineer.

Winnipeg, Man.—Tenders will be received until 12 o'clock noon, October 7th, by the C.N. Ry. for construction of Athabasca St. subway. H. A. Dixon, chief engineer.

Winnipeg, Man.—City council contemplates construction of a pavement on Newman St., and favors the removal of car tracks from River St., which will be paved as a residential thoroughfare. W. P. Brereton, city engineer.

York Township, Ont.—Contracts have been awarded by township council, for construction of concrete sidewalks as follows: To Walton and Rowell, Atlas Ave., 4 ft. 6 ins., $4,375; St. John's Rd, 5 ft., $4,600; St. Clair Ave., n.s., 5 ft., city limit to Jane St., $4,500. To Angotti and Smythe, Dennis Ave., s.s., 1,067 lin. ft., $2,875; Medway Ave., 234 lin. ft., $775; Frejama Ave., from Lambton to Cæsar, 1,218 lin. ft., $3,200. Frank Barber, engineer.

York Tp., Ont.—Tenders will be received until 12 o'clock noon, October 6th, by township council for construction of concrete sidewalks on Brownhill Ave., Eversfield Ave., Keene St., Lauder Ave., Glenholme Ave., Barr Ave., Pape Ave. and Weston Rd. Engineer, Frank Barber, 40 Jarvis St., Toronto.

WATER, SEWAGE AND REFUSE

Agassiz, B.C.—By-law has been passed by the Kent municipal council providing for the following works in draining 1,280 acres on Hammersley prairie: Earth fill, $1,200; installation of a concrete culvert and sluice gate; clearing and resurfacing of the old dam; removal of present pumping station and erection in a more suitable site. Total cost, $4,800. Engineer, Frank Sweatman.

Brandon, Man.—The Public Utilities Commission will undertake an exhaustive survey of the waterworks system to detect large leakages and to plan for enlargements.

Dundas, Ont.—F. F. Fry, of Toronto, who has the contract for installation of sewers, will have completed most of the work before winter. The sewer which commences at King and York St. and runs along York St. to the town hall will be constructed partly in tunnel.

East Kildonan, Man.—Contracts will soon be awarded for supply of piping, valves, hydrants and fittings; construction of sewers on Munroe and Watt St.; construction of water mains on East Kildonan Rd., Helmsdale Ave. and Oakview Ave. H. Thompson, secretary-treasurer.

East Kildonan, Man.—Council will construct sewers on Watt St., from Munroe Ave. to city limit; Munroe Ave., from Roch St. to Watt St. Water mains on East Kildonan Rd., from Trent Ave. to Leighton Ave.; Helmsdale Ave., from East Kildonan Rd. to Kildonan Dr.; Oakview Ave., from lane west of East Kildonan Rd. to East Kildonan Rd. H. Thompson, secretary-treasurer.

Eriksdale, Man.—Tenders will be received until 12 o'clock noon, October 3rd, by the municipal council for drilling drainage wells as follows; North of section 35-21-5 w., north of section 33-21-5 w., n.e. corner section 33-21-6 w., n.w. corner section 33-21-6 w. J. Sharpe, secretary-treasurer.

Fort William, Ont.—Board of works has recommended construction of sewers on Luci Court.

Galt, Ont.—City council will construct sewer and storm drain on Borden St., from First Ave. to Stanley St.; Stanley St., from Borden St. to Tait St.; Tait St., from Stanley St. to Francis St. Estimated cost, $3,006.89. J. McCartney, clerk.

Kirkfield Park, Man.—Contracts will soon be awarded by the council of the rural municipality of Assiniboia, for construction of a sewer and laying of water mains on Kensington, King Edward, Oakdale Place, Sutherland and Munroe Streets, also for supply of cast-iron pipes, hydrants and valves. Frank Ness, secretary-treasurer.

Medicine Hat, Alta.—City council has requested city engineer to prepare a report on construction of water mains throughout the Purmal subdivision.

London, Ont.—The Public Utilities Commission have three plans for conservation of domestic water: (1) Installation of meters on all services; (2) construction of an additional reservoir at Springbank; (3) supply the G.T. Ry. and as many other large consumers as possible with river water. Two pumps will be in operation, supplying river water in a short time. Meters are being placed on new services. A report will be submitted to the commission in reference to

20-Year Barrett Specification Roof on Hog Pens of Union Stock Yards, Ltd., Toronto, Canada. Architects: Union Stock Yards, Ltd. General Contractors: Archibald & Holmes, Toronto, Can. Roofers: The Maitland Roofing & Supply Co., McDermid Bros. Successors, Toronto, Can.

100,000 Square Feet of Barrett Specification Roofs

The above photograph shows the mammoth new Hog Pens of the Union Stock Yards, Ltd., Toronto, in process of construction.

This is a roofing job of more than one hundred thousand square feet, covering one continuous building, extending back beyond the sixth monitor in the picture.

Naturally, in deciding what type of roof to adopt for this enormous plant, the question of cost had to be given careful consideration.

It is significant, therefore, that a Barrett Specification Roof should have been decided on.

It means that the Union Stock Yards architects fully realize what so many architects and builders have come to appreciate—that it *pays* to buy the *best* roof because, while the original cost may be a little higher, *the cost per year of service is lower than for any other type.*

This plant has a roof that will stand up year after year under the rigorous Canadian climate; one that takes the base rate of insurance and that is guaranteed for 20 years.

Guaranteed for 20 Years

So sure are we of the service Barrett Specification Roofs will give *under the most severe conditions* that we are prepared to *guarantee them for 20 years*, in all towns of 25,000 or over, and in smaller places where our Inspection Service is available, provided they are 50 squares or more in area. The guaranty costs you nothing. We merely require that our Specification dated May 1, 1916, shall be strictly followed and that the roofing contractor be approved by us. The guaranty is a Surety Bond issued by a well-known fidelity and guaranty company.

A copy of The Barrett 20-Year Specification, with roofing diagrams, sent free on request.

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cost and location of the proposed new reservoir. E. V. Buchanan, waterworks manager. H. A. Brazier, city engineer.

Maidstone, Ont.—Tenders will be received until October 11th by the council of Sandwich South township for repair of the Oldcastle drain. J. McAuliffe, clerk.

North Bay, Ont.—By-law has been passed by town council providing for improving, extending, altering and enlarging existing sanitary sewerage system on part of Worthington and Sherbrooke St. Estimated cost, $25,640.75. M. W. Flannery, clerk.

North Vancouver, B.C.—Extensive improvements are contemplated by the district council to be undertaken early in the next year. It is proposed to either enlarge the present dam at the Mosquito waterworks intake, supplying water to the North Lonsdale district, or construct an additional dam.

Pembroke, Ont.—Contract has been awarded by town council for construction of storm sewers on Forced Rd., Government Rd., Somerset St. and Christie St., to Behan and Leeney. A. J. Fortier, town clerk.

Peterborough, Ont.—E. A. Peck, solicitor for the corporations and boards of health of the municipalities of Otanabee, North and South Monaghan, has submitted an application to the Ontario Municipal Board, asking for an order to restrain the city of Peterborough, from emptying sewage into the river and to compel council to purchase a site for the erection of sewage disposal plant.

St. Jean, Que.—City council will proceed to construct water mains on Richelieu St., between Lemoine and St. Charles St., and a sewer on Jacques Cartier St., between the C.P. Ry. and St. Paul St. H. Morais, secretary-treasurer.

St. John, N.B.—City council contemplates construction of a sewer on Protection St. G. N. Hatfield, city engineer.

Toronto, Ont.—The board of control has recommended the construction of the following water main extensions: Durie St., 6 ins., 280 ft.; Webb Ave., 6 ins., 480 ft.; Bastedo Ave., 6 ins., 470 ft.; Evans Ave., 6 ins., 280 ft.; Evans Ave., 6 ins., 400 ft.; Cleveland St., 6 ins., 580 ft.; Cluny Dr., 6 ins., 545 ft.; Windermere Ave., 6 ins., 336 ft. Estimated cost, $8,904.59.

Toronto, Ont.—Contracts have been awarded by the board of control for construction of sewers as follows: College St., Beatrice St. to Palmerston Ave., brick, $31 per lin. ft. and College St., from Palmerston Ave to Spadina Ave., brick, $21.61 per lin. ft., to the Connolly-Agnew Construction Co. Hastings Ave., Queen St. and Leslie St., to 700 ft. n. of Queen St.; Coady Ave., Queen St., to 700 ft. n. and Eaton Ave., Danforth Ave., to 500 ft. n., will be costructed by day labor under direction of the department of works.

Walkerville, Ont.—City council will construct a 10-in. crock sewer in the alley between Dacotah and Oneida Sts. and in alley between Oneida and Seminole St. A. E. Cock, clerk.

Walkerville, Ont.—The Walkerville Water Co. has under construction the following water mains: 15,146 lin. ft. of 6-in. pipe, 3,140 lin. ft. of 8-in. pipe, 3,000 lin. ft. of 10-in. pipe and 2,400 lin. ft. of 12-in. pipe. C. D. Brown, secretary-treasurer.

Winnipeg, Man.—The commissioners of the Greater Winnipeg Water District have received tenders and will soon award contract for supply and construction of a water line between the 66-in. pipe line of the water district and the municipal reservoir at the town of Transcona. R. D. Waugh, chairman.

Woodstock, Ont.—Ure and Son, consulting engineers for the city of Woodstock on sewage disposal, have recommended against the activated sludge process on account of the cost and are investigating another system at present in operation in Toronto, Ont. Plans are being prepared along the latter lines and will soon be submitted to council.

York Township, Ont.—The Trust and Guarantee Co., on behalf of the Robert Davies estate, have applied to council for construction of water mains on Thorncliffe Bvd., from Chester Hill Bvd. to Cambridge Ave., and on Chester Hill Bvd., from Don Mills Rd. to the Davies property.

York Township, Ont.—Ratepayers of Todmorden and North Danforth districts, York township, are considering obtaining a supply of water either through the proposed new Scarboro system, or by construction of an independent plant.

LIGHT, HEAT AND POWER

Bedford, Que.—Town council passed by-law authorizing purchase of the Bedford Light Co.'s electric plant and water system. W. Giroux, mayor.

Chatham, Ont.—The public utilities commission have purchased the electrical business of the Chatham Gas Co. Cost, $2,000 per year for 20 years without interest, and 1917 scrap value for all equipment.

Edmonton, Alta.—City council has taken over the local power plant, the owners having refused to operate in consequence of the rejection of a request for increased rates by the Public Utilities Commission.

Edmonton, Alta.—The Edmonton city council is to be asked to join with other municipalities in urging the Alberta government to look into the hydro-electric possibilities of the province, with the object of establishing public-owned generating stations similar to the system in Ontario. The following locations are mentioned as possible sources of power: Athabasca River, 250 mls. n. of Edmonton, 170,000 horse-power; Red Deer River, at Red Deer, 7,000 horse-power; Bow River, Calgary, 48,000 horse-power; Saskatchewan River, 65 mls. w. of Edmonton, 50,000 horse-power.

Lakefield, Ont.—The Hydro-Electric Power Commission will immediately construct a transmission line, from dam No. 5, to supply all necessary power for Lakefield. Sir Adam Beck, chairman.

Pembroke, Ont.—Town council has prepared agreement with the Pembroke Electric Light Co. for a new street lighting system and for removal of company poles from Main St. A. J. Fortier, town clerk.

Peterborough, Ont.—The new transmission line being constructed from Healey Falls to Peterborough, will also provide power for Norwood, Havelock and the surrounding township.

Sault Ste. Marie, Ont.—Lake Superior Power Corporation are contemplating additions to hydro-electric power plant to supply the Algoma Steel Co. with additional power in case the latter company adopts the present plans for extensions to steel plant. A. E. Pickering, manager of power company, is investigating various makes of water turbines and electrical equipment.

York Township, Ont.—Application has been made to council by the Trust and Guarantee Co., on behalf of the Robert Davies estate, for construction of electric lighting system on Thorncliffe and Chester Hill Blvd.

York Township, Ont.—The Toronto Hydro-Electric system will construct lighting systems on Jane St., East Dr., Bexley, Pendeen, Sibley and Walnut Avenues, Divers St., Roach Ave. north of Alice St., Greenwood, Mortimer and Cosborn districts and Montye Ave.

York Township, Ont.—Council contemplates construction of hydro-electric lighting systems on the following streets: Atlas Ave. to north end; Arlington Ave. to Normanna Ave.; Mulberry Ave., from Atlas to Vaughan Rd.; Holland Park Ave., from Mulberry Ave. to Oakwood Ave.; Barrie Avė., from Atlas to west end; Watford St., from Atlas Ave. to west end.

RAILWAYS

Edmonton, Alta.—The department of railways and canals will shortly lay steel on additional mileage on the Blindman Valley Railway. It is understood that the C.P. Ry. contemplate purchase of this railway.

Fort William, Ont.—The Utilities committee has recommended the purchase of interlocking and derail switches for use on the street railway system. Estimated cost, $1,900.

BURLINGTON
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S
STEEL
BARS
FOR CONCRETE
REINFORCING
CO LTD
ROUNDS SQUARES
TWISTED SQUARES
FLATS CHANNELS ANGLES
SPECIAL SECTIONS
BARS BENT TO SHAPE FOR BEAMS, STIRRUPS, ETC.
PROMPT SHIPMENT

Guelph, Ont.—Engineers from the Hydro-Electric Power Commission are going over the property of the Guelph Radial Ry. and will report on the cost required to place the railway in good condition.

Kitchener, Ont.—The special committee of the council and light commission, appointed to report on the Waterloo-Wellington railway has recommended that the railway be purchased by the city, provided a satisfactory price, based on the earning power of the road, can be agreed upon.

London, Ont.—The London Railway Commission will request city council to issue debentures to raise at least $200,000 for improvements to the London and Port Stanley Ry. This by-law will probably be voted upon next January. J. E. Richards, manager.

Ottawa, Ont.—City council will have plans prepared for construction of extensions to the Ottawa Electric Railway Co., when that company's franchise expires, and the railway is taken over by the city in June, 1923. Alderman Ford.

Saskatoon, Sask.—The C.P. Ry. will construct a branch line, from Saskatoon to Milden, connecting with the Bassano line somewhere near Empress. W. R. MacInnis, vice-president, C.P. Ry.

Sunny Brae, N.S.—Petitions, requesting the Dominion government to construct a railway from Sunny Brae to Guysboro and thence to Mulgrave, are being prepared. Estimated distance, 93 mls.

Toronto, Ont.—City council has passed a by-law providing for extension of the Bloor St. civic car line to Runnymede Rd. Cost, $160,000.

Toronto, Ont.—The Ontario Railway Board has approved plans for the Mount Pleasant civic car line. Tenders will be called by the city council immediately.

Toronto, Ont.—It is announced that the Hydro-radials will be equipped with standard steel sleeping cars of the same size as the steam railway pullman cars.

Toronto, Ont.—By a vote of 17 to 3, the city council decided to assume its share of the 10 per cent. guarantee in connection with the construction of the western hydro-radials.

Toronto, Ont.—It is expected that the ratepayers will vote on a by-law providing for construction of the Hydro radial from Toronto easterly toward Bowmanville next January. Estimated amount of by-law, $4,000,000.

Toronto, Ont.—The proposed eastern Hydro-radials will enter Toronto by a north and south line in the vicinity of Morley Ave. It will subway at Danforth Ave., and elevate at Queen St. It is expected that should the Hydro Commission purchase the Metropolitan radial on Yonge St., this proposed north and south line will accommodate both systems.

Winnipeg, Man.—The commissioners of the Greater Winnipeg Water District are endeavoring to obtain a grant from the Dominion government for their railroad, which is developing a large section of the province of Manitoba. R. D. Waugh, Winnipeg.

FACTORIES AND LARGE BUILDINGS

Barrie, Ont.—Town council has passed a by-law providing for alterations and additions to West Ward school, and for improvements to the South Ward school. Estimated cost, $77,000. A. W. Smith, clerk.

Brockville, Ont.—By a vote of 877 to 1, the by-law providing a free site for the proposed factory for the Brockville Paper Manufacturing Co. was passed by the ratepayers. Construction of factory will proceed immediately.

Carleton Place, Ont.—Tenders will be received until October 6th, for additions and alterations to Central School. Separate tenders will be received for heating and plumbing. Architect, J. L. Kingston, 310 Booth Building, Ottawa.

Ford City, Ont.—Contract has been awarded by A. Smith, D. M. Ferry Seed Co., for construction of a dwelling, to W. N. McEachran Sons, Ltd., Toronto. Contract price, $10,000.

Fredericton, N.B.—The John Palmer Co., Ltd., are constructing a brick addition to their factory on Argyle St. Additional floor space, 15,000 sq. ft. Contractor, John C. Smith. Contract price, $25,000.

Guelph, Ont.—The Guelph Chamber of Commerce will apply to legislature for incorporation of a company to be known as the Guelph Arena Co., Ltd., $50,000. Enclosed skating rink to be constructed on Cambridge St. Building to be two-story, seating capacity, 1,800, ice surface, 80 by 180 ft., and to have a rest room, 32 by 84 ft. Provisional directors, J. M. Taylor, F. E. Partridge, H. Quarmby, W. A. Mahoney, E. Macdonald.

Halifax, N.S.—Tenders will be received by the department of public works, Ottawa, until 12 o'clock noon, October 8th, for construction of a garage at the Bellevue Military Hospital, Halifax. Plans, etc., office of chief architect, Ottawa, superintendent of military hospitals, Halifax, and superintendent of Dominion Buildings, Halifax. R. C. Desrochers, secretary.

Hamilton, Ont.—H. Hazel will erect a brick apartment house at the corner of Caroline and Bold St. Estimated cost, $17,000.

Hamilton, Ont.—The International Plow Co. are constructing additions to buildings. Estimated cost, $200,000. A. C. Dann, superintendent.

Hamilton, Ont.—The Dominion Canners will erect a modern plant in the industrial section near the Hamilton Bridge Co. Estimated cost, $1,000,000.

Hanover, Ont.—Ratepayers will be asked to vote on by-law granting loan of $30,000 for reconstruction of flour mill, recently destroyed by fire. Owner, E. Knechtel. A second by-law will provide $10,000 for building of a park.

Ingersoll, Ont.—A by-law providing for construction of a sixteen-roomed central school, will be voted on by the ratepayers on October 17th.

Kenora, Ont.—The Kenora Rink Co. will be incorporated and construction of a new rink building will be commenced immediately. Estimated cost, $23,500.

Keremeos, B.C.—Tenders will be received until 12 o'clock noon, October 4th, by the department of public works, Victoria, for construction of school addition. Plans, etc., office of J. Mahony, Court House, Vancouver, H. Hunter, Princeton and W. G. Mattice, Keremeos. A. E. Foreman, engineer, Victoria.

Kitchener, Ont.—City council will raise funds to provide for construction of an additional water gas plant, which will double the present gas capacity. Estimated cost of construction, $50,000. G. Lippert, chairman of light commission.

London, Ont.—The board of education will have plans prepared for construction of a new collegiate institute to be built in East London. City council for 1920 will be asked to prepare by-law amounting to $250,000.

Mimico, Ont.—Tenders will be received until 2 p.m., October 8th, by the Mimico Housing Commission, for construction of twenty-two brick or tile, six-room, detached and semi-detached houses. Architect, H. R. Watson, 907 Excelsior Life Building, Toronto.

Moncton, N.B.—Jones and Davis, of St. John, N.B., will erect a factory for their new pork packing business.

New Glasgow, N.S.—The C.N. Ry. is preparing for construction of extensions and alterations to the station building at New Glasgow. F. R. Brady, general manager, eastern lines, Moncton, N.B.

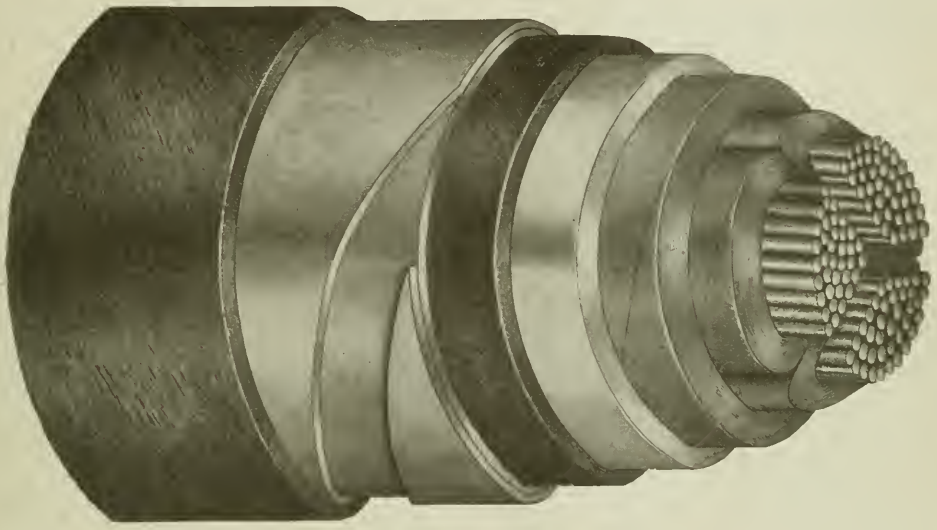
Niagara Falls, Ont.—It is announced that contracts have been awarded for construction of a big steel plant to be located between the M.C. Ry. and Chippawa creek. C. Phillips, St. Catharines, resident engineer on construction.

Ojibway, Ont.—The Canadian Steel Corporation plan construction of mills on an extensive scale. Many improvements will also be constructed throughout the town. Estimated cost, $75,000,000.

Portage la Prairie, Man.—It is expected that an additional oatmeal mill will be erected in the near future.

Portage la Prairie, Man.—The Portage school board contemplates the construction of a new four-room school building to be built in the central grounds this fall.

PAPER INSULATED CABLES



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Port Colborne, Ont.—The government elevator will be rebuilt as soon as the wrecking operations under way are completed. The Dominion Bridge Co. have the wrecking contract.

Quebec, Que.—J. Ritchie Co., Ltd., will erect a modern factory building on Ste. Helene St. Estimated cost, $32,000.

Regina, Sask.—H. G. Smith and Co., will erect a warehouse building. Storey and Van Egmond, architects.

Rouleau, Sask.—Plans have been prepared for construction of a skating and curling rink. Architects, Storey and Van Egmond, Regina.

Saskatoon, Sask.—Construction has commenced on the new C.N. Ry. depot freight and office building. Estimated cost, $75,000. J. A. Simmons, contractor.

Saskatoon, Sask.—The Adams Harness Manufacturing Co., Ltd., contemplates erection of warehouse on First Ave. C. M. Adams, Toronto.

Tate, Sask.—Tenders will be received until 12 o'clock noon, October 4th, by the school board for construction of a school building. G. W. Hager, secretary-treasurer.

Toronto, Ont.—The property committee, city of Toronto, will call tenders for construction of a new roof for the city hall.

Toronto, Ont.—A brick and stone church will be constructed on Eversfield Rd., Earlscourt district. Seating capacity, 400.

Winnipeg, Man.—Tenders will be received until 3 p.m., October 15th, by the city council for alterations and repairs to the city pound building on Logan Ave. West. C. J. Brown, city clerk.

Winnipeg, Man.—City council has passed by-law to provide for borrowing $1,000,000 from the province to be loaned to citizens for construction of houses. It is expected that some of these houses will be erected this fall.

Winnipeg, Man.—The works committee has been requested by A. L. Cuffe, representing more than 100 airmen, to establish an airdrome. Possible sites mentioned: Eaton's playground, Norwood golf course, East Kildonan park and the exhibition grounds.

Woodstock, Ont.—The Bean and Westlake Co. contemplates a further enlargement to their plant on Brock St.

York Township, Ont.—Tenders will be received until October 9th, for an eight-room addition to Secord Ave. public school, No. 26, as follows: Reinforced concrete, brick work, hollow tile, terrazzo floors, steel casement sash, carpentry work, electrical work, plastering and painting. S. B. Coon and Son, architects, 810 Excelsior Life Building, Toronto.

MISCELLANEOUS

Cardston, Alta.—Tenders will be received until October 13th, for alterations to building and installation of hot water heating plant in the hospital at Cardston, Alta. Architects, H. M. and W. A. Whiddington, Lethbridge, Alta. H. E. Kelly, secretary-treasurer, Cardston Municipal Hospital District No. 5, Spring Coulee, Alta.

Dundas, Ont.—Two proposals for a soldiers' memorial have been made. The first took the form of a hospital, while the second, which seems to be in greater favor, calls for a monument with inscribed tablets, to be erected on the market square.

Ingersoll, Ont.—Plans have been prepared for construction of a memorial entrance to Central Park. Estimated cost, $4,000. F. H. Leake, secretary, Horticultural society.

London, Ont.—Contract has been awarded by city council for supply of pump to Goldie and McCulloch. Contract price, $1,470. H. A. Brazier, city engineer.

Montreal, Que.—Announcement has been made by the Dominion Bridge Co., Ltd., that they will equip entire plants for manufacture of intricate machinery for the pulp and paper manufacturers.

Nanaimo, B.C.—The C.P.R. will install a freight handler and make other improvements in connection with their wharf. Estimated cost, $20,000.

Ogden, Alta.—The department of natural resources, C.P.R., have called tenders for excavation of approximately 17,000 cu. yds. earth near Ogden, Alta. A. S. Dawson, chief engineer.

Pembroke, Ont.—Town council has awarded contracts as follows: Cast-iron pipe and special to National Iron Works, Ltd., Toronto; rejected tenders from Stewart and Bowden, Canada Iron Foundries, Ltd., and Dunlop and Co. Valves and hydrants for mains on Allister and Isabella Streets, to Dunlop and Co.; rejected tender from Stewart and Bowden. Sewer pipe and specials, to Dunlop and Co.; rejected tender, Stewart and Bowden. A. J. Fortier, town clerk.

Peterborough, Ont.—The foundation for the Hunter St. bridge pier, second from the river, will be constructed 3 ft. below top of hard clay, which extends another 5 ft. to solid rock, according to report submitted to council by H. W. Middlemist, engineer, Ontario Municipal Board. Frank Barber, consulting engineer, Toronto.

Port Arthur, Ont.—The Lighthouse board of the department of marine and fisheries has recommended construction of a light and fog alarm station at Angus Island. Estimated cost, $50,000. F. H. Keefer, Port Arthur.

Saskatoon, Sask.—The North Star Oil Co., have announced their intention of locating a mixing and distributing plant at Saskatoon.

St. Catharines, Ont.—A by-law to provide funds for purchase of about 10 acres of land in the north-western part of the city to be used as an athletic park, will be submitted to the ratepayers for approval next January.

St. Catharines, Ont.—An additional appropriation of $750,000 for construction work on the Welland canal has been assured by Hon. J. D. Reid, minister of railways and canals, Ottawa. James Marsh, vice-president of the labor federation.

St. John, N.B.—City council contemplates repairs to the ferry docks. Estimated cost, $8,000. G. N. Hatfield, city engineer.

St. John, N.B.—Contract has been awarded by the city council for repairs to trestle on West Side, to E. A. Farren. Contract price, $1,898. Rejected tenders from R. R. Lee, $2,385; J. A. Adams, $2,667; S. H. Mayes, $2,700; H. O. Clarke, $2,800; Ring and Irons, $3,100; Engineers and Contractors, $3,160; W. R. Monroe, $3,257. G. N. Hatfield, city engineer.

Toronto, Ont.—The officials of the Metropolitan church have commenced tearing up the old concrete pavement on the church grounds and will erect 32 standards for lighting purposes.

Toronto, Ont.—Contract has been awarded by the board of control to James Morrison Brass Mfg. Co., Toronto, for supply and delivery of 2,400 stop cocks. Contract price, $1.80 each.

Toronto, Ont.—Contract has been awarded by the board of education for installation of a 3.0 system oil-burning equipment for Glenholme school, to Sheppard and Abbott, $2,556, and for the John Ross Robertson school to Fess Oil Burners, Ltd., $3,547.

Toronto, Ont.—Contract has been awarded by board of control for supply of piping as follows: 24 and 20 ins. diam., cast iron, to National Iron Corporation, Toronto, $108.85 and $91 per length; 16 ins. lap-welded, to Drummond, McCall and Co., $6,286. Supply of valves as follows: 24 ins. diam., Bawden Machine Co., $3,240; 20 ins. diam., Drummond, McCall and Co., $330. Supply of kerosene engine for asphalt plant, to International Harvester Co., $525.

Vancouver, B.C.—City council decided to purchase 10 dump cars to haul gravel from Coquitlam, B.C.

Vancouver, B.C.—Tenders will be received until 12 o'clock noon, October 15th, by city council, for supply of 4,000 lin. ft. of 2.5 ins. rubber-lined cotton hose for the fire department. J. Stuart, purchasing agent.

Vancouver, B.C.—Coughlan and Sons, shipbuilders of Vancouver, will construct a great graving dock on property recently acquired on Burrard Inlet. It is understood that the company plans to continue production of large-capacity steel ships for private use.

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PRINCIPLES OF REINFORCED CONCRETE CONSTRUCTION *Third Edition. Revised and Enlarged.*

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C.E.—10-2-19

Vancouver, B.C.—Tenders will soon be called for construction including necessary dredging and filling, of the C.P.R. Co.'s new pier, to be located between piers "A" and "D," on Burrard Inlet and to cost several million dollars. F. W. Peters, general superintendent for C.P.R. in British Columbia.

Walkerville, Ont.—Hiram Walker and Sons, Ltd., are calling tenders until October 6th, for construction and delivery of one 3,500-gals. per min., turbine-driven, centrifugal pumping unit for the pumping station supplying water to the Walkerville Water Co. R. W. Pratt, consulting engineer. C. D. Brown, secretary-treasurer.

Windsor, Ont.—Ratepayers have endorsed by-law providing for purchase of a motor fire engine. Estimated cost, $15,000.

Winnipeg, Man.—Tenders will be received by the public school board until 5 p.m., October 9th, for supplying 1,056 school desks. P. H. Smith, secretary-treasurer.

Winnipeg, Man.—Ratepayers will vote on by-law providing for establishment and operation of a modern milk and milk product distribution plant. Estimated cost, $600,000.

Winnipeg, Man.—Tenders will be received until 3 p.m., October 6th, by the committee on fire, water, light and power, for supply of electric cooking ranges. C. J. Brown, city clerk.

Condensed Advs.

Advertisements under this heading at following rates per insertion, with fifty cents per insertion as minimum rate in any case; "Positions Wanted," one cent per word; all other condensed advertisements, three cents per word. Payable in advance; 50 per cent. extra if charged.

WANTED technically trained man, with view to taking up designing of electrical apparatus, principally A.C. motors. An opportunity for the right party. Box 9, *The Canadian Engineer*, Toronto.

CIVIL ENGINEER.—15 years' experience since graduation—wants connection with Consulting Engineer or Contractor, for full or part time. Good education, wide experience, and creditable record in construction, including design, estimating, reports, and supervision. Box 11, *The Canadian Engineer*, Toronto.

MANUFACTURER in Eastern Townships, having good facilities and considerable experience in the production of a wide variety of machinery lines, desires to undertake the manufacture (for the Canadian or export trade) of American or English machinery. Full particulars gladly upon request. Box 396, *Canadian Engineer*, Toronto.

MECHANICAL DRAUGHTSMEN.—Wanted first-class man, experienced on details of crane and conveying or paper machinery. Technical training preferred, but must be able to produce results and accept responsibility as well as handle detail design. Also required two or three men with knowledge of machine design and ability to produce detail drawing ing with accuracy and despatch. Apply giving experience and salary required in writing to the Mechanical Engineer, Dominion Bridge Company, Limited, Montreal. 358

COMMISSARY work for construction undertakings is my specialty. Before entering this line, I had eight years' experience as an accountant in the Canadian Bank of Commerce in Toronto and other Canadian cities. Am a Canadian, married, good references. During last year of war had entire charge of all feeding and living accommodations, timekeeping, etc., for large shipbuilding corporation in United States. Interview solicited. Address Box 398, *Canadian Engineer*, Toronto.

Tenders Called For

UNITY, SASK.

Sealed Tenders registered and endorsed on the envelope, Tenders for (tender bid on) and addressed to J. M. Jensen, Secretary-Treasurer of the Town of Unity, Sask., will be received up to 6 p.m., October 15th, 1919, for the supply, delivery and erection of the following machinery and materials and for the performance of certain works:—

Tender A. For the supply, delivery and erection of one internal combustion engine.
Tender B. For the supply, delivery and erection of one generator excitor, switch-board, transformers, meters, etc.
Tender C. For the supply and delivery of one oil storage chamber.
Tender D. For the supply and delivery of pole, wire and line material.
Tender E. For the erection of electric pole line.
Tender F. For the erection of Power station and cooling tank.

Marked cheque for five per cent. (5%) of the amount of the bid must accompany each tender.

Complete sets of plans and specifications may be seen at the office of the Consulting Engineers, Saskatoon, at the Secretary-Treasurer's office, Unity, Sask. Specifications on tenders A., B., C. and D. may be seen at the office of *The Canadian Engineer*, Winnipeg and Toronto, and the Contract Record office, Montreal.

J. M. JENSEN, Esq.,
Secretary-Treasurer,
Unity, Sask.
MURPHY & UNDERWOOD,
Consulting Engineers,
Saskatoon, Sask.
352

NOTICE TO CONTRACTORS

Sealed tenders marked "Tender for Concrete Structures" will be received by the undersigned until 12 o'clock noon on Tuesday, October 14th, 1919, for the construction of the concrete structures on the Provincial Highway in the Township of Pittsburgh. Plans, Specifications and Forms of Tender may be seen on and after Monday, October the 6th, at the Office of the Resident Engineer, Gananoque, at the Office of the City Engineer, Kingston, and at the Office of the undersigned. A marked cheque for Five Hundred Dollars payable to the Minister of Public Works and Highways Ontario must accompany each tender.

The lowest or any tender not necessarily accepted.

W. A. McLEAN,
Deputy Minister of Highways.
Department of Public Highways, 359
Toronto, September the 30th, 1919.

Among the newly-incorporated companies which were recently granted charters by the British Columbia government is the Cameron Construction Co., Ltd., which will take over the business formerly carried on at Victoria, B.C., by S. Cameron, contractor and lumber merchant; also the Veterans' Engineering and Contracting Co., Ltd., with authorized capital of $50,000.

The Canadian Engineer

A Weekly Paper for Civil Engineers and Contractors

Studies in Surface Area Proportioning Method

Discussion of R. B. Young's Paper Published Under Above Title in the June 26th, 1919, Issue of The Canadian Engineer—Surface Area vs. Fineness Modulus—Results of Tests on Bulking Effect of Moisture in Sands

By LLEWELLYN N. EDWARDS
Senior Highway Bridge Engineer, U.S. Bureau of Public Roads

IN a theoretical study, having for its object the development of a well balanced, practical method for designing concretes, we are inevitably bound to recognize two natural divisions of the subject.

These divisions are, however, very closely interrelated and cannot be considered altogether independently. One of these involves a consideration of the physical and chemical properties of the constituent materials; the other a consideration of the methods and operations which enter into the "transition" or "making" stage.

Experience has amply proven that the latter may operate to vitalize and to develop in the finished product all the latent

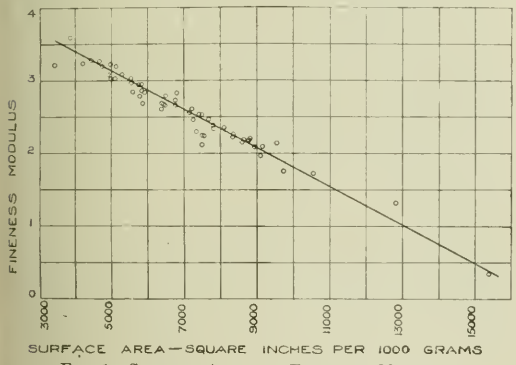


FIG. 1—SURFACE AREA VS. FINENESS MODULUS

functions possessed by the materials or, on the contrary, they may serve to render these functions wholly, or in part, impotent. inert and useless.

It is a situation in which we have two groups of forces tending under favorable conditions to co-ordinate and under unfavorable conditions to disrupt. Naturally enough this dual condition has resulted in a certain amount of confusion in the interpretation of results obtained from experimental tests.

The theoretical studies made by Mr. Young have shown quite conclusively that the grading of the aggregate, or more specifically its surface area, bears a very definite relation to the strengths of mortars and concretes. The relations which he has shown to exist between the surface area, and the cement and the water contents of the mix, are fundamental. Further studies and experimental tests will show a still wider application of this surface area factor than has yet been developed.

When the surface area method of proportioning mortar and concrete mixes was first presented, discussion brought forth the claim that the grading of the aggregate, and consequently its surface area, influenced the strength of a mortar or a concrete only to the extent of fixing the quantity of water necessary to produce a plastic mix. In view of my own investigations and the conclusions drawn from them, I was prepared to accept this notion only with definite limitations, rather than in the "blanket form" in which it was offered.

It is obvious that if we are to establish a uniform method for the testing of the mortar and concrete-making qualities of sand and stone aggregates, we must aim to eliminate factors depending upon the judgment and personal equation of laboratory operators.

The visual or "guess by eye" determination of a "plastic mix" is too indefinite for adoption as part and parcel of such a method.

The writer recognizes fully the importance of the water content of mortar and concrete mixes, both as regards its proper function and its influence when used in excess of that required for the fulfilment of that function. However, he is not prepared to believe that the interpretation of its full effect is based upon the relation of the water to the cement contained in the mix, that is, upon the water-cement ratio.

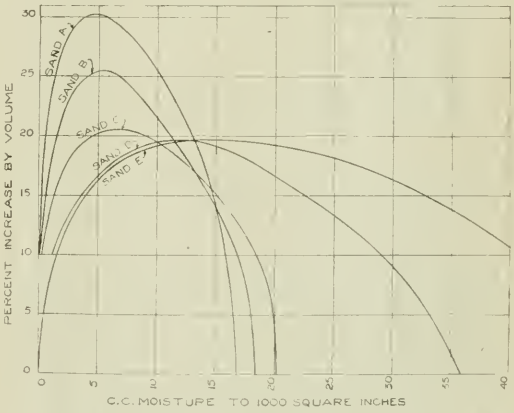


FIG. 2—BULKING EFFECT OF MOISTURE IN SANDS—VOLUME INCREASE IN RELATION TO AREA-WATER CONTENT

The fundamental principles of the surface area method of proportioning preclude the unqualified acceptance of this ratio. In so far as the surface area method is concerned, it is an indirect function rather than a primary one. It varies rather indirectly with the richness of the mortar or the concrete mix.

It is of interest to note that in Table No. II.,* Mr. Young has brought out very clearly the effect of the cement content as tending to vary the water-cement ratio, and has shown that for uniformly moist mixes this ratio is variable. His conclusions are in full accord with the consistency theory of the surface-area method.

The theoretical studies described by Mr. Young do not touch upon the effect of sandy dust (material passing a No. 100 sieve) in its relation to the water content of mortar and concrete mixtures. In the very limited concrete tests described in the writer's paper published in *The Canadian Engineer* in July, 1918, the dust content of the sand aggregate was treated as having the same surface area as an equal portion of material passing a No. 80 and retained upon a No. 100 sieve, and the cement content was proportioned accordingly. As regards the water content of the three concrete mixes described, the paper referred to states that the water content of the mix was sufficient to produce a saturated, sticky, semi-plastic mortar showing no free water. In other words, the water content was determined by visual examination rather than by a specific rule. The speaker's investigations of the surface area method had not then extended to the development of a rule or formula for the determination of the water content of a uniformly moist concrete mix. However, the results of the tests appeared to be amply consistent to indicate the adaptability of the surface area method to concrete mixes, and for this reason alone they were included.

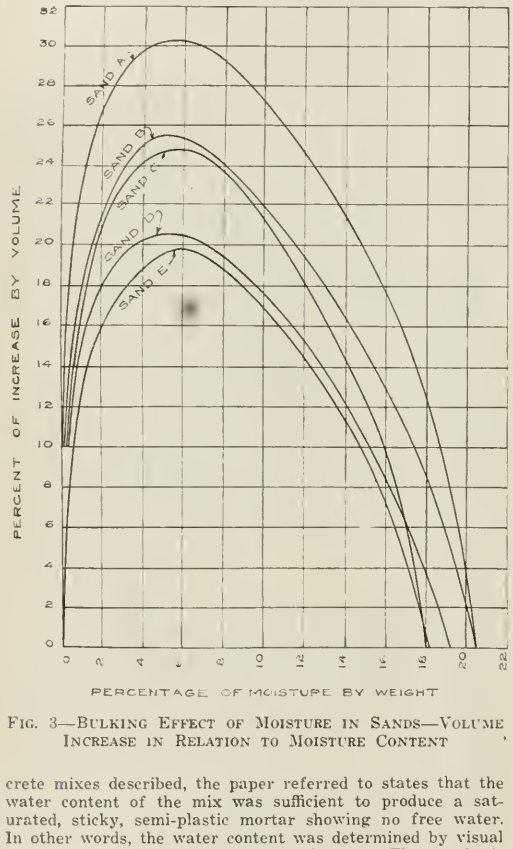


FIG. 3—BULKING EFFECT OF MOISTURE IN SANDS—VOLUME INCREASE IN RELATION TO MOISTURE CONTENT

Tests made within the past six months with the object of obtaining information relating to the effect of sandy dust, have shown quite conclusively that the assumptions just referred to were entirely wrong in principle. Speaking briefly, these tests show that in proportioning the cement content, no allowance should be made for the surface area of dust material and that the water allowance for moistening the dust is nearly equal per unit of weight to that required per unit weight of cement. In other words, we must treat the dust as a "dilutant" or "extender" of the cement, rather than as a component part of the sand aggregate. Incidentally, it may be said that these tests have shown ample evidence of both the reliability and the advisability of the common practice of limiting the dust content, by weight, to approximately 5% of the sand aggregate.

*See *The Canadian Engineer*, issue of June 26th, 1919, p. 565.

Investigation of Various Aggregates

For a proposed concrete structure, the consideration of possible sources of supply of aggregates frequently involves the laboratory examination of the concrete-making qualities of two or more different aggregates varying in their granulometric composition and other physical properties. The field conditions attending the mixing, handling, placing and finishing of the concrete, as well as the ultimate strength, durability, etc., of the concrete producible from them, require that the relative merits of these aggregates be determined under conditions eliminating variations in the relative plasticity and the final strength of the cement matrix which performs the function of holding together the particles of the sand and stone aggregates. When the aggregate contains sandy dust it is important that allowance be made for the quantity of water required to moisten it.

Having determined under uniform conditions the relative concrete-making values of the materials, the question of their adaptability to the production of workable, plastic concrete mixes capable, in the "transitory" stage, of being formed with a reasonable amount of work into the various shapes required in its adaptation to the construction of bridges, buildings, roadways, etc., can be fully and systematically considered. The quantity of water required for absorption by the aggregate and for moistening its surfaces remaining constant, an increase in the water content over that used in the tests, produces a dilution of the cement paste which ultimately results in a weakening of the cement matrix. Unfortunately, many investigations have overlooked the basic importance of the cement matrix, and have evolved their investigations upon the assumption that the mobility of the mix is a primary rather than a secondary factor. The very nature of the component materials and the varied proportions in which they are used, render such an assumption untenable.

The determination of the effect upon the strength of mortars and concretes resulting from an increase in the water content has been the object of studies and tests made by several investigations, so that a considerable volume of information is now available. Doubtless the tests, formulas, etc., reported by Prof. Duff A. Abrams, Lewis Institute, Chicago, Ill., are the most complete, exhaustive and reliable.

Laboratory Testing of Concretes

Having discussed, at least to a limited degree, the fundamental requirements for the investigation of aggregates, it will not be amiss to indulge in a brief consideration of the conditions which are of vital importance to the laboratory testing of concretes and to the establishment of standard methods and practices. While several conditions of lesser importance might be enumerated, the three most important basic conditions entering into comparative tests are the following:—

1.—The water content of the mixes must be sufficient to permit the production, without loss of water, of uniformly sound, well-moulded specimens.

2.—The water content of each mix must be so proportioned as to produce for a given cement a uniformly strong cement matrix.

3.—The cement content of each mix must be so proportioned as to provide a uniform and equal quantity of matrix in relation to the surface area of the aggregates.

In a series of tests adapting the principles just mentioned to laboratory conditions, it has been found that concrete mixes containing a uniform broken stone aggregate,

sand aggregates differing in their granulometric analyses (their surface areas varying from 1,830 to 2,490 sq. ft. per 100 lbs.), and with cement contents varying (by ½ lb.) from 1 lb. to 4 lbs. per 100 sq. ft. of surface area of total aggregates, produced generally excellent working conditions when the water content of the mixes was proportioned as follows:—

Water to moisten cement equals weight of cement multiplied by the percentage of water required to produce normal consistency paste.

Water to moisten surface area of aggregates equals 12 cc. per 1,000 sq. ins., equals 0.381 lb. per 100 sq. ft.

Water to moisten dust, if any, equals 0.381 lb. per 100 sq. ft. of surface area, its surface being assumed to be equal to that of sandy material passing a No. 100 sieve and retained upon a No. 200 sieve.

In these tests the concretes produced from lean mixes containing 1 lb. and 1½ lbs. of cement per 100 sq. ft. were harsh, and required an extra amount of labor to effect the placing in the moulds. All other mixes were plastic, the cement paste which they contained being sufficient to lubricate the surfaces of the aggregates. The fat mixes, containing over 3 lbs. of cement per 100 sq. ft., could have been easily placed in the moulds had they contained a slightly less quantity of water. Economy of construction requires that the increased strength thus attainable be taken account of in actual field construction operations.

The origin and development of the water factor for moistening the surfaces of the aggregates and dust will be described by the aid of diagrams.

Surface Area vs. Fineness Modulus

At practically the same time as Mr. Young was seeking to establish a mathematical relation between surface area and fineness modulus, I was engaged in a somewhat similar effort, not with the object of corelating these methods, but, instead, of finding out just how fineness modulus short-circuited the surface area, as had been claimed.

Just how much efficiency is lost by the short circuit is not clear. Fig. 1 shows the results of studies made with over fifty natural sands. It gives the impression that possibly the fineness modulus is intermittently or otherwise "grounded" on surface area. However, like Mr. Young, the writer was unable to establish a definite mathematical relation.

Reverting now to the consideration of the water content of the concrete test mix in its relation to the surface area of the aggregates, it is a well-known fact that while the weights of sands vary with the character of the rock materials from which they take their origin, and also with their granulometric composition, yet, for any given sand, its weight per cubic foot when dry is greater than its weight when wet, provided, of course, that in each case the sand is shoveled into the measuring receptacle. This condition holds true even when the wet sand is subjected to a moderate amount of compacting.

Approved practice in mortar and concrete testing is based upon the use of weighed quantities of dry aggregate, and only upon this basis can the test results be properly interpreted. It is axiomatic that if results consistent with those secured in the laboratory are to be obtained upon field construction work the conditions under which the aggregates are measured, more especially the sand aggregate, must be such as to assure reasonable uniformity in the net volume.

Bulking Effect of Moisture

Notwithstanding the above conditions, there is a marked paucity of published data relating to the effect of varying quantities of water contained in sand aggregate used in mortars and concretes. Its absence is evidence that this factor has not been given sufficient attention by engineers, architects and construction men.

With the primary object of securing information relative to the "bulking" effect of moisture in sands differing in their granulometric analyses, tests were made by the Department of Works, Toronto, under the direct supervision of the writer. Paradoxical as it may seem, these tests have shown that the surface area of the sand particles is a direct function of the volume increases produced by varying the quantity of water.

In describing the tests very briefly, it may be said that the volume-weight method was used for determining the quantity of each sand to be used in the tests; the weight being determined in each case from an average of four tests. Natural sands were used. Two series of tests were made upon each sand, the water content being varied in the first in relation to the weight of the sand and in the second in relation to its surface area. A uniform distribution of the water was secured by working the sand with a trowel or other tool. To secure the desired degree of accuracy, each intermediate test was repeated four times. From these tests, involving eleven different sands, average volume-increase curves were determined. Fig. 3 shows, for five of these sands, the relation of volume-increase to percentage of water content. One per cent. of water was amply sufficient to coat thoroughly the surface of the sand particles. The "bulking" effect resulting mainly from the cohesive action of this small quantity of water, ranged in the tests from 11% to 23%. Two other interesting features of this diagram are the "saturation" stage producing maximum volume, when the water content approximates 5% to 7%, and the "flooding" stage, at which the volume of the sand is the same as that originally

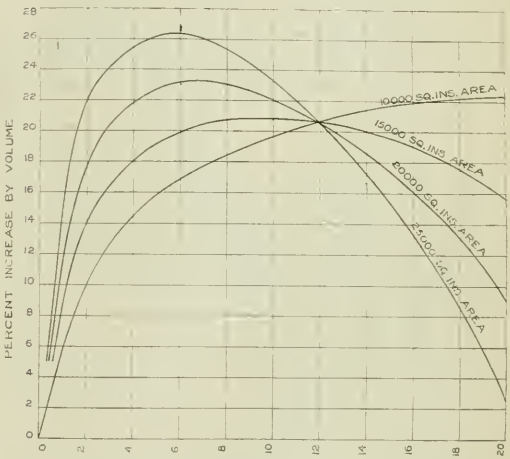

PERCENT INCREASE BY VOLUME
C.C MOISTURE TO 1000 SQUARE INCHES AREA
10000 SQ. INS. AREA
15000 SQ. INS. AREA
20000 SQ. INS. AREA
25000 SQ. INS. AREA

Fig. 4—Bulking Effect of Moisture in Sands—Experimentally Determined Relation of Volume Increase to Area-Water Content

occupied by it when thoroughly surface dried. The water content for the latter varied from 18% to 28%. Careful observation at this stage failed to discover a tendency of the sand to fall below its original dry volume.

The area-water series of tests led to a rather interesting and entirely unlooked for discovery. Fig. 2 shows, for the five sands shown in the diagram "Fig. 3," the relation of volume increases to the area-water content Special attention is called to the indications of the existence of a "nucleus" common to all the curves. Although the writer had confidently expected that this series of tests would show the existence of a relation of "bulking" effect to the area-water content, yet this indication of a condition common to all sands tested was quite unforseen.

From a systematic study of the experimentally determined curves, we have deduced those shown upon Fig. 4. Each curve in Fig. 4 was derived mathematically from a consideration of all those determined experimentally. Attention is called to the actual existence of the "nucleus" indicated upon the previous diagram. The water-area ratio of this rather mysterious point is 12 cc. per 1,000 sq. ins., which corresponds to the water factor (0.381 lbs. per 100 sq. ft.) used for moistening the surface of aggregates and dust in concrete test mixes.

The claim is not made that the volume-moisture condition just described bears a direct relation to the many factors involved in concrete making. However, its actual use in this connection has indicated its efficiency as a working tool. We can, I believe, ill afford to cast it aside without a full and careful trial to prove or disprove its value. It is entirely possible that physical factors other than cohesion and adhesion enter into this peculiar volume-moisture condition. In so far as the speaker has a knowledge, its existence has not been previously discovered. However, independent and more recent investigations made by Mr. Young have shown corroborative and unquestionable evidence of its existence.

Since the moisture content in a sand has the rather remarkable effect of increasing its volume by holding the sand particles somewhat rigidly in positions different from those they would readily assume when dry, it seems reasonable to aim to control this "bulking" effect, so far as is possible, in test mixes for concrete.

There is no evidence that the "bulking" effect of the moisture in sands has been given consideration either in written specifications or in field operations incident to mortar and concrete-making. Its consideration will show the fallacy of the commonly used volumetric method in so far as resulting strengths are affected by the moisture contained in the sand aggregate, and will inevitably lead to the opinion that the adoption of methods and appliances whereby the aggregates will be measured by weight rather than by loose volume, will result in a greater uniformity and reliability of the mortars and concretes produced. Important practical considerations render it advisable to continue the present practice of using in concrete mixes a volume of mortar equal to approximately one-half of the gross volume of the stone aggregate.

Proposed Tidal Power Development at Hopewell

Dams and Power-House at Confluence of Petitcodiac and Memramcook Rivers—Initial Installation of 90,000 H.P. Would Cost Approximately $122 per H.P.—Paper Read at Engineering Institute's Fifth Professional Meeting, September 11th, at St. John, N.B.

By W. RUPERT TURNBULL
Consulting Engineer, Rothesay, N.B.

FIRST, and in a brief manner, we should review the tidal developments and proposals of the past, so that you will be led, as I have been, to think that the first large tidal development in the world will probably be carried out at Hopewell, N.B., the little village that lies closest to the tidal estuaries, the Petitcodiac and Memramcook, where nature has founded two great natural reservoirs with the exception of the dams that must be built to complete them.

Old charters show that tidal power was used in England, for grinding corn, as early as the 11th century, and tidal mills have been in operation for the same purpose, from that time to the present day. The following extracts are taken from an excellent article by W. C. Horsnaill, that appeared in "The Engineer," London, Eng.:—

"No records exist showing how the earliest tide wheels were arranged, but particulars are available of several mills which were erected in the eighteenth and nineteenth centuries. In the earlier historic mills no attempts were made to produce a fall, the power being obtained from the flow of the water into and out of the pound. To develop power in this way, a wheel similar to the paddlewheels of steamships was used, but with a reversed action; that is to say, the flow of water drove the wheel. This arrangement entailed the raising and lowering of the wheel to suit the rise and fall of the tide, as only the bottom floats could be immersed if the best results were to be obtained.

Layout of Old Mills

"A corn mill at one time existed at East Greenwich which was driven by tidal power in the way we have described. The pound has an area of about 4 acres and the wheel measured 11 ft. in diameter by 26 ft. long. The power was transmitted by a bevel gear at either end of the water-wheel shaft, the pinions being free to slide up and down two square vertical spindles. The water-wheel and bevel gears were mounted upon a frame which was caused to rise and fall to suit the tides, and the power was transmitted by either bevel wheel according to which way the water-wheel was running, the other bevel pinion being thrown out of gear. By these means the machinery in the mill was always driven in one direction, in spite of the reversal of the water-wheel at each turn of the tide.

"The movable frame, with the water-wheel and gear, weighed some 20 tons and the bottom of it was extended to form a kind of shutter, which filled up the opening underneath the wheel race, all the water flowing into or out of the pound being thus compelled to pass through the wheel.

"Another type of wheel was devised to overcome the drawback of having to move up and down with the tide. This wheel was fitted with hinged floats, which arranged themselves across the stream at the bottom of the periphery, while they travelled through the water edgeways during the remainder of each revolution. With floats of this type the wheel was fixed, and the tide gradually rose over it until in some cases complete immersion took place.

This Design Soon Discarded

"An arrangement of the sluices was also adopted to compel the water to pass through the wheel in the same direction, whether flowing in or out of the pound, thus doing away with the need for reversing gear between the water-wheel and the machinery to be driven.

"These wheels must have been very inefficient, as the loss of power caused by the drag of the upper portion when covered was serious, and the design was soon discarded.

"Following these earlier mills came the more recent examples, many of which are still in existence, while a few of them may be seen in operation. The older mills aimed at using the current of water caused by tidal action, and advantage was taken of the flow in either direction. The more modern tide wheel is arranged to operate with a considerable fall, and only develops power when the water is flowing out of the pound.

"The undershot wheel with straight radial floats is usually adopted, and the mill is started at half ebb or a little later, work being continued for about five hours, or until the water rises under the wheel and chokes the tail race. These arrangements give only five hours of working during each tide."

Listing the tidal mills that actually exist: There is a mill at Woodbridge of 10 to 12 h.p. and one at Walton-on-the-Naze of 85 h.p. These are both small powers, working on a low range of tide, and with only a single, small, natural reservoir that allows of only a partial use of the tidal power for a comparatively short period of time, but Mr. Horsnaill shows that if modern turbines were installed at the plant at Walton-on-the-Naze, and the power used to develop electricity instead of grinding corn, it would show up as a commercial development somewhat better than gas power in spite of a heavy outlay for storage batteries, which would be necessary at a plant situated as is Walton.

The number of proposals for tidal plants is very considerable, and while I think I should not take up your time by discussing all of them, it is worth while to examine a few of the more serious ones.

James Saunders discussed, in the "Engineering Review" of London, Eng., three great plants for developments in England; namely, at Chichester Harbor, at the Menai Straits, and in the Bristol Channel. But in each case either the head of the water was too low, or the cost of forming the artificial reservoirs was too great, to make the proposals commercial at present. His most promising scheme is that for the Bristol Channel, where the tidal head is quite sufficient for successful operation but where the cost of forming the great artificial reservoirs that would be required is prohibitive in relation to the power obtained. The total cost of the plant figured out at $47,000,000 and the horse-power at 240,000 so the cost per h.p. would be $196.

Cost Excessive in England

C. A. Battiscombe, before the London Society of Engineers, also made a tidal proposal for the Bristol Channel, but his cost works out at $237 per h.p., and while neither of these figures would be too high for commercial developments *in some localities*, they are too high to interest English capital, for England is still a country of cheap coal, and in examining *any* hydro-electric development we must constantly keep in mind the cost of power from other sources.

Mr. Boving has proposed a tidal plant for the River Dee, but no estimates of costs are given; and coming nearer home, there have been numerous proposals for obtaining power from the tides at Sackville, at Cape Split, and at the Reversible Falls of St. John. To get *continuous* power at any of these sites, it would be necessary to form large artificial reservoirs, and the formation of such reservoirs is so costly that these proposals are not, at present, commercially feasible.

The Three Main Requirements

The three great desiderata for a tidal plant are:—

1.—That there should be sufficient height of tide to obtain a good head.

2.—That there should be two natural reservoirs of large size so that continuous power can be obtained.

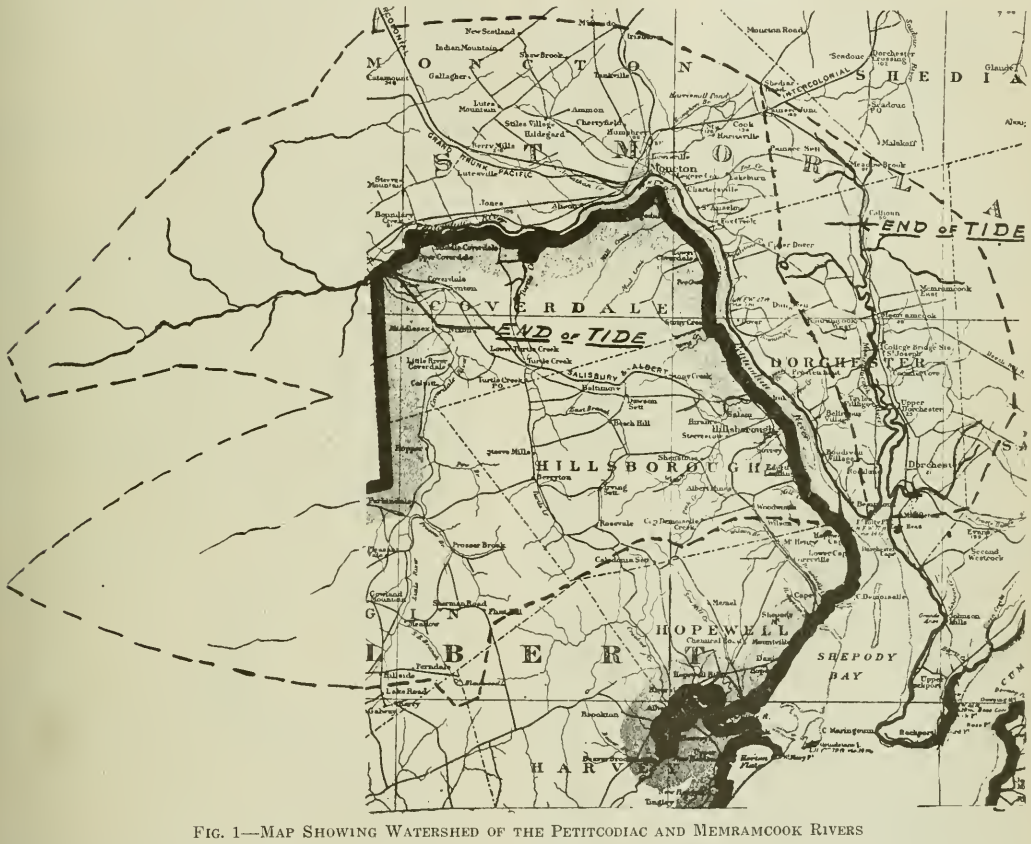


FIG. 1—MAP SHOWING WATERSHED OF THE PETITCODIAC AND MEMRAMCOOK RIVERS

3.—That the power plant should be central to the population that would be served.

And it is these three desiderata that lead us to suppose that the *first* great tidal development in the world will take place at Hopewell. Here we have two large reservoirs almost completely formed by nature, we have a tide which is exceedingly regular and that ranks among the highest tides in the world, with a spring rise of 45 ft., a neap rise of 38 ft., and a normal neap range of 32 ft., and we have this power centrally located to a present population of 250,000 who are *literally starving* for cheap electric power, with no other hydro-electric development in sight, except small ones and those that are too distant from the centres of population to make their development commercial at the present time.

I have examined many other sites for tidal power in those parts of the world where the tides are sufficiently high

to make tidal power at all possible, and I am firmly convinced that we have at Hopewell the site that is most promising at the present time, from a commercial standpoint.

I will now discuss the principle which I have proposed for obtaining continuous power from these great tides. Fig. 1 is a map of the two tidal estuaries, the Petitcodiac and the Memramcook rivers. This map shows the general trend of these rivers, and their confluence at Hopewell, and it also shows the fresh-water drainage areas of the two rivers, which, although a minor item as compared to the great volume of salt water that flows up and down these rivers, should still be borne in mind in reviewing this proposal.

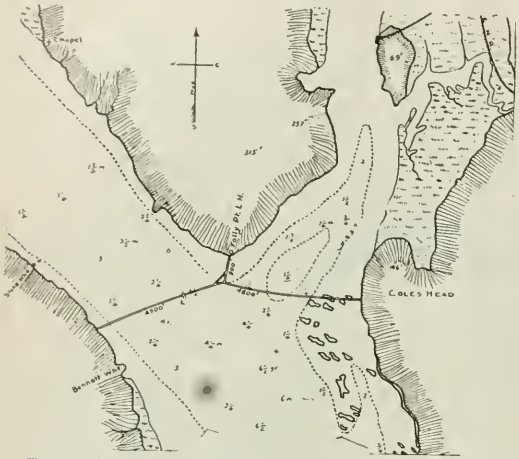


FIG. 2—CONFLUENCE OF PETITCODIAC AND MEMRAMCOOK RIVERS

The dotted lines show the respective drainage areas approximately, and these have been calculated to show a drainage basin for the Petitcodiac of 784 sq. miles, and for the Memramcook of 134 sq. miles, or in the ratio of nearly 6 to 1.

At present the flood tide makes up these rivers for approximately six hours and then turns and flows back into the bay for 6½ hours, and this map also shows the approximate limits of this flow, above which points the streams are fresh water.

Fig. 2 is a scale chart of the confluence at Hopewell of these two rivers, the proposed location of the dams that will be necessary to control the waters, the depths of water at low tide, etc.

Dams Two Miles Long

The western dam would be 4,900 ft. long, the eastern dam 4,800 ft. long, and a wing dam of 900 ft. would connect the two, and it would, of course, be part of the plan to have a highway and trolley line (operated by the plant) over the tops of these dams, connecting up the two main shores and the long peninsula between the two rivers. This highway would only be a matter of local benefit, but it would be of immense benefit to the building up of this locality. At present Hopewell can only be reached from Cole's Head by a little ferry that can only operate for a few hours near high tide. The Petitcodiac is only bridged at Moncton, 19 miles above Hopewell. The Memramcook was bridged at Upper Dorchester, 5 miles above Hopewell, but this bridge is now gone, and the government is at present making borings for a new bridge that will cost about $1,000,000.

At present Hopewell, Hillsborough and the bog peninsula are hard places to get into, and still harder places to get out of, and yet they are regions of great mineral resources that only require, but still await, development. In Fig. 2 is indicated a lock in the western dam, through which vessels could be passed at any suitable time of the tide on their way up and down the Petitcodiac. Hillsborough and Moncton would be provided with deep water harbors instead of the mud flats which they at present enjoy at every low tide. The gates of the locks would naturally be swung by electric power furnished by the nearby power house.

The proposal provides for making the Petitcodiac a high level basin in which the water would always be high, and be replenished at every high tide, while the Memramcook river would be a low level basin to be partially filled from the high level basin and to be always emptied during the latter part of the ebb tide. This arrangement would also suit local conditions admirably, for the Memramcook is exclusively a farming district in which much time and money is at present expended in excluding the tides by means of dykes, and I have been informed by farmers of this valley that they would only wish to have the salt water flood their lands about once in ten years for the purpose of fertilizing them. The navigation of this river is practically nil, so it would hardly be necessary to provide any lock in the eastern dam. Two or three times during a summer a small vessel will lie at the Dorchester Island wharf for the purpose of discharging goods, but these could be as well discharged below the dam and the power company could well afford to pay for the short extra haulage.

Continuous Operation, Varying Head

Fig. 3 illustrates—in scheme but not to scale—the principle that I propose to employ to get continuous power from the tides, with a varying head to be sure, but with the water always passing through the turbines in the same direction, and always with a head sufficient to make turbine operation successful. The diagram shows the confluence of the two rivers, with the necessary dams and gates to control the flow. The gates (J) in the western dam would be automatic flap-gates, opening up-stream, allowing the high level basin (the Petitcodiac) to fill at every high tide. The gates (H) of the eastern dam would be automatic flap-gates, opening down stream, allowing the low level basin (the Memramcook) to empty on every ebb tide. The gates (G and G_1) would be in the nature of lock-gates. They would be operated by electric motors driven by the power-

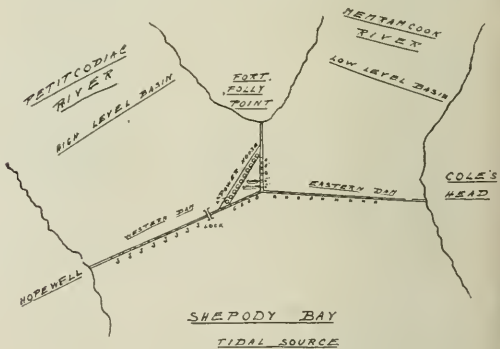


FIG. 3—LAYOUT FOR OBTAINING CONTINUOUS POWER FROM THE TIDES

plant itself, and under the control of the attendants, who would open them and close them, in accordance with the height of the external tide, at stated times that can be fixed for months in advance directly from the tide tables.

The power house is represented as a long building, with turbines (T) extending diagonally from the wing dam to the western dam, these turbines discharging continuously from the high level basin into the common, triangular, spillway.

Let us now follow through a cycle of operations from low tide to the following low tide, remembering that the high level basin was filled automatically at the last high

tide, and that the low level basin has just been emptied during the ebb tide, through the gates in the eastern dam.

Beginning with low tide we may at first leave gates (G) open and allow the water from the spillway to discharge directly into the tidal supply (Shepody Bay), but the head will gradually decrease as the tide rises, and at about 2½ hours rise the attendants close gates (G) and open gates (G¹), allowing the discharge from the spillway to enter the low level basin. Into this low level basin, the spillway will continue to discharge for about 6½ hours, or through the last 3½ hours of flood tide and through the first 3 hours of ebb tide, after which time the water in the low level basin will have so risen, and the water of the tidal supply will have so dropped, that it will now be profitable to close gates (G¹), and open gates (G), and once more allow the discharge to occur directly into the source of tidal supply and give the low level basin time to drain out again on the ebbing tide.

Tide is Very Regular

I think that from this the simplicity of the system itself is evident, but in order to study more fully one of the engineering problems involved, Fig. 4 shows the typical tidal cycle at Hopewell. This curve shows a copy, in per cent. of range plotted against time, of an actual tidal record obtained at the ordinary neap tides by the tide gauge established this summer at Hopewell by the Canadian Tidal Survey, and furnished to me by the courtesy of H. W. Jones of that department. You will note how exceedingly regular the tide is, and how little affected by estuary flow, and this is one of the great advantages of Bay of Fundy

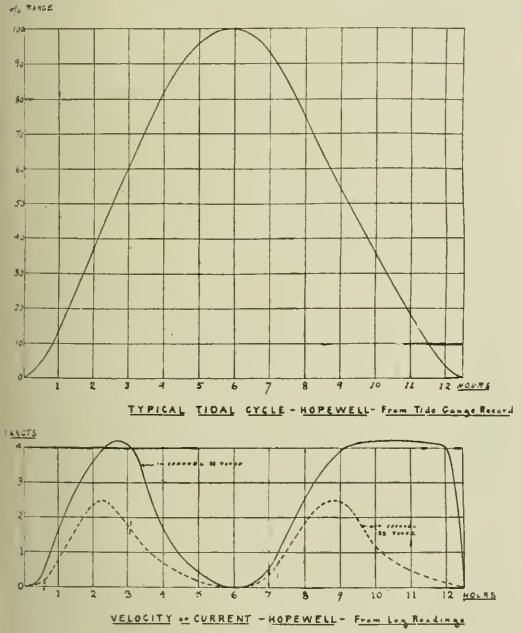


Fig. 4—Typical Tidal Cycle at Hopewell

tides, in general. At certain places in the world the diurnal inequality becomes so great that, for several days there is only one tide in 24 hours, and at Southampton there is a second high water occurring about two hours after the first.

In dealing with the question of tidal power at Hopewell, it must be remembered that although the tide is regular in type, nevertheless the *range* of the tide, and not the *rise* is the limiting factor of our power calculations, and it becomes necessary to establish and work on what might be called a "standard range." For this purpose I have analyzed approximately the ranges that will occur in the course of a year. I call spring tides those whose range exceeds 42 ft. They occur about 15% of the time, and I think no attempt should be made to utilize them especially. I call subnormal neap tides those whose range is less than 32 ft. They also occur about 15% of the time, and some means, which are discussed later, would need to be employed to avoid the impairment of our "standard" amount of power.

All other tides I call ordinary neap tides, with a range, at Hopewell of 32 ft. to 42 ft. They occur about 70% of the time, and its is the lower range of 32 ft. that I think

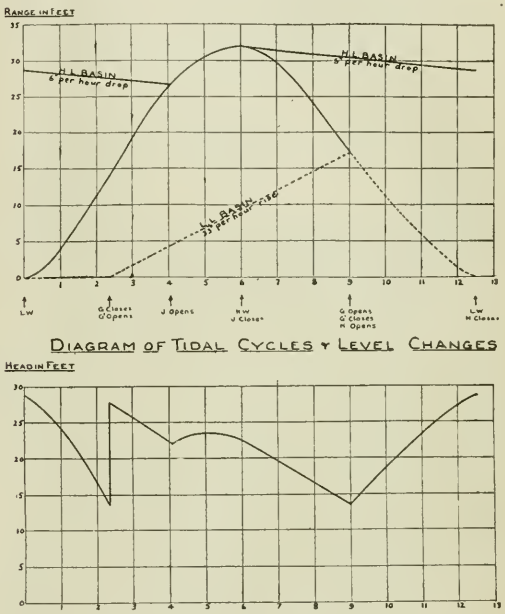

RANGE IN FEET
H.L. BASIN 6" per hour drop
H.L. BASIN 6" per hour drop
L.L. BASIN 33" per hour drop
L.W.
G. Closes G' Opens
J Opens
H.W. J Closes
G Opens G' Closes H Opens
L.W. H Closes
DIAGRAM OF TIDAL CYCLES & LEVEL CHANGES
HEAD IN FEET
CORRESPONDING CHANGES IN EFFECTIVE HEAD

Fig. 5—Tidal Cycle at Standard Range of 32 Ft.

we should adopt as our "standard range," and the curves and estimates that follow are based on this range of 32 ft.

Fig. 5 shows a tidal cycle at a "standard range" of 32 ft., with an assumed drop in the high level basin of 6 ins. per hr., the level change that will occur in the two basins with the operation of the plant as before described. If the conditions at Hopewell were absolutely ideal, the ratio of effective areas would be as 2 to 1 for the high and low level reservoirs, but unfortunately this is not the case, for the Petitcodiac contains an effective area of about 330,000,000 sq. ft. while the Memramcook has only about 60,000,000 sq. ft., so that the ratio is about 5½ to 1. While the water in the Petitcodiac is dropping 6 ins. per hr., the water in the Memramcook is rising 5½ times this, or 33 ins. per hr., and these level changes are illustrated in Fig. 5, while the changes in effective head on the turbines are plotted in the lower portion of the same figure.

Operation at "Standard Range"

Full lines show the level changes of the high level basin; dotted lines, those of the low level basin. Starting at low water, for 2.35 hours the level of water in the low level basin is unchanged, for the water from the spillway is discharging into the tidal supply direct, but during this time the head is decreasing from 28½ ft. to 13½ft., when it becomes expedient to discharge into the low level basin, when the head will at once rise to 27½ ft.

After this, for 6½ hours the low level basin will rise, but the high level basin will also rise after 4.1 hours (as the

flood tide will then be filling in for 1.9 hours) and we have the head decreasing from 27½ ft. to 22 ft., but afterwards increasing to 23½ft. at 5.2 hours.

After this the head will gradually decrease to 13½ ft. at 9 hours, when the tide in the external bay having sufficiently ebbed, the water from the spillway will be again discharged into it and the head will steadily rise to its previous maximum of 28½ ft. at low tide, as shown by the curve of heads.

The average head, in this case, from low tide to low tide works out at 22¼ ft.

It will perhaps be wondered why I select a drop of 6 ins. per hr. for the high level basin, and what the difference would be if we selected a greater or lesser drop. Up to a certain maximum, which would occur at about 250,000 h.p. and at a 26 in. per hr. drop, the available horsepower increases with an increase in the hourly drop allowed. However, it must be borne in mind that as the hourly drop increases, the maximum head decreases, and the minimum head decreases more rapidly still, and we soon reach a case that cannot well be met by any ordinary turbines.

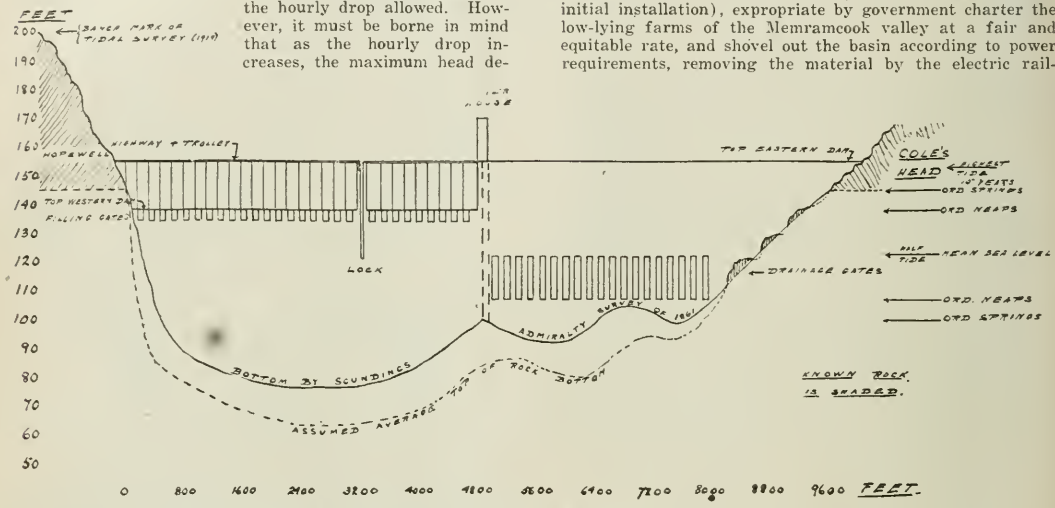


FIG. 6—APPROXIMATE PROFILE OF PROPOSED DAMS, HOPEWELL HYDRO-ELECTRIC PLANT

To illustrate this, a 4-in. drop in the high level basin gives maximum head of 30¼ ft., minimum of 20 ft., and average of 26½ ft., but 6 in. drop gives 28½ ft. maximum, 13½ ft. minimum and average of 22¼ ft., and this seems to be about the maximum relative range over which we can expect a single turbine to act; we could employ duplex turbines, mounted vertically on the same shaft to the same generator, but with separate draft tubes (as suggested by James Saunders), but this means considerable added cost and is to be avoided if possible.

We are thus forced to adopt one of those compromises that are often met with in engineering design, and must adopt a drop in our high level basin that will entail such a range of head that can be successfully met by the turbine designer. I am at present in correspondence with many of the leading turbine manufacturers and have no doubt they can largely overcome this difficulty of this variable head, in a moderate priced turbine, but the whole question of this variable head problem is so novel to them that the correspondence is necessarily lengthy to get them to understand the conditions involved in a tidal plant. However, one maker shows a turbine that gives 5,000 h.p. at 120 ft. head and efficiency of 86%, and also the same horsepower at 220 ft. head and 80% efficiency, all at a constant speed of 300 r.p.m., so I think we can have no doubt that once the conditions involved at Hopewell are understood by the manufacturer and designer, we can obtain turbines that will meet the assumed condition of a 6 in. hourly drop in our high level basin and with a probable average turbine efficiency of about 83%.

As a matter of fact the initial installation called for at the present time by the existing population, would be about 90,000 gross horsepower, and we can readily calculate that this corresponds to an hourly drop of 4 ins. in the high level basin. Now, as the population grows, and the demand for electricity increases from 90,000 to 120,000 h.p., we can steadily improve the ratio of the two basins and thus greatly improve our power output (up to say 200,000 h.p.) and yet never exceed the limit of 6 in. hourly drop which I have assumed as the present practical limit of single-turbine operation.

To improve this basin-ratio to the ideal condition in which the Memramcook would have half the effective area of the Petitcodiac, I propose to use electric shovels and an electric tramway (both operated by surplus power from the initial installation), expropriate by government charter the low-lying farms of the Memramcook valley at a fair and equitable rate, and shovel out the basin according to power requirements, removing the material by the electric railway and dumping it below the eastern dam where it would be largely carried away by the tide or could be formed into a useful embankment—wharf, railway terminal, or the like.

Fig. 6 shows the approximate profile of the western and eastern dams. Since it would not be policy to attempt to get the extra power that spring tides would give, the western dam need only have the height of high water, ordinary neap tides, but the height of the eastern dam would have to be carried up beyond the highest probable spring tides to insure that the low level basin would never be flooded at high tide. Fig. 6 shows this dam carried 3 ft. higher than the highest spring tide that occurred during a period of 15 years. As before mentioned, the tops of the dams could be utilized as highways, and would thus be of invaluable local benefit, and a light steel structure is indicated on the western dam for this purpose. The masonry width called for by the calculations would not be sufficient for a roadway, but a light steel structure could be winged out on top of the dams and made of sufficient width to carry a good roadway, an electric tram and the power transmission lines that would go both west to St. John and east to Halifax.

The flap-gates for filling the high level basin and emptying the low level basin are indicated in the sketch-profile. They should present no engineering difficulties, but they should be designed of sufficient size to pass readily the full volume of water required by the final and maximum development.

We now come to the question of the river bottom and the location of rock for a good dam foundation, and here I must apologize, for I cannot give any exact data. I took

(Continued on page 372)

BACKFILLING THE RED RIVER TUNNEL

Concrete Poured Around 60-In. Cast-Iron Pipe in 10x10-Ft. Rock Bore by Dropping it 70 Ft. From Trestle Across River

By J. Armstrong
Division Engineer, Greater Winnipeg Water District, Winnipeg, Man.

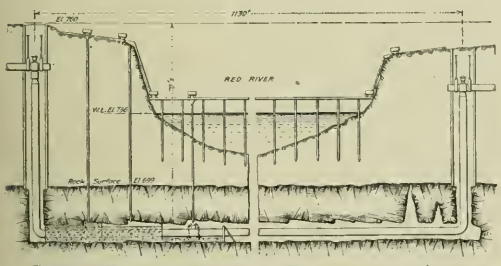
OVER 1,100 ft. of the new Winnipeg aqueduct is in tunnel under the Red river, with the roof of the tunnel about 70 ft. below the high part of the ground and 40 ft. below the river level. The 60-in. cast-iron pipe carrying the water was concreted here into the 10 by 10-ft. tunnel by concrete dropped through holes bored at intervals from the surface.

The tunnel bore is through the solid limestone rock, the rock roof being some 17 ft. in thickness, with overlying soils of various clays, silts, and other river deposits. The rock was found to be fairly hard but badly seamed both horizontally and vertically and containing many pockets of varying size up to two or three cubic yards, evidently the result of water action at some remote period, but now filled with a white, chalky clay. The first 400 ft. of the tunnel from the eastern end discharged considerable water into the boring from these seams, although not in sufficient quantity to require the aid of compressed air, a 4-in. submerged centrifugal pump handling the water at all times with ease. The remaining 600 ft., although seamed and checked, seemed tighter, and comparatively little water was added from this portion.

Practically Perfect Hydrostatic Action

The original tunnel section was designed with a circular roof, but owing to the seamy condition discovered the section was changed to a 10 by 10-ft. square. The eastern shaft is some 2 ft. lower than the western shaft, to facilitate drainage during construction.

The water is conveyed through this tunnel in a 60-in. cast-iron lining. The contract required that after this lining was in place the remaining space in the tunnel bore be backfilled with concrete in such a manner as to guarantee an



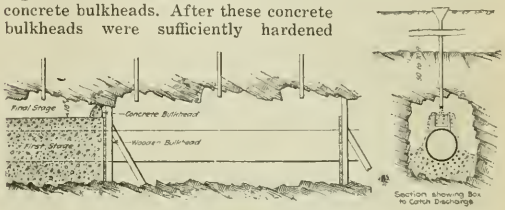
Section Through Red River Tunnel of Winnipeg Aqueduct, Showing Method of Concreting Pipe

absolute filling of all irregularities and pockets. The specifications specifically prohibited the use of compressed air in placing the concrete. After much study the method adopted was by means of well holes bored from the surface through the roof of the tunnel. These holes were drilled with an ordinary well-drilling machine and lined with a 6-in. well casing from the surface to the rock. The spacing of the holes was somewhat irregular but averaged 40 ft., the holes being bored to this spacing at the nearest high spot in the tunnel roof.

For the river crossing a light trestle was built consisting of two-pile bents spaced 8-ft. centres with four longitudinal 8 by 8-in. stringers to act as bracing and to bear the light industrial track carrying the concrete cars. A mixing plant was provided at each end of the tunnel consisting of a ¾-yd. mixer, industrial tracks and concrete cars of various types.

The first operation consisted in the pouring of a concrete floor in the tunnel carefully graded to facilitate the placing of the 60-in. cast-iron lining. This concrete, some 250 yds., was all poured down one hole at the western end and distributed by cars using the same track previously employed in the tunnel excavation and later used to transport the cast-iron pipe.

When the lining was in place the tunnel was bulkheaded off in sections of various lengths and concrete poured until within 18 ins. or 2 ft. of the roof. This was allowed to set and succeeding sections were poured. During the operation a concrete dam or bulkhead was built back on the set concrete, these dams being about 120 ft. apart, thus leaving three well holes between each two concrete bulkheads. After these concrete bulkheads were sufficiently hardened



Sections Showing Details of Concreting Aqueduct by Dropping Through Pipes

to withstand the pressure the final concrete was poured. The two end holes in each compartment were used to discharge the concrete, leaving the middle hole for observation purposes. In every instance when the end holes were filled the concrete rose in the middle or observation hole to the same level, showing a practically perfect hydrostatic action. As these holes provided a head of from 55 to 70 ft. of fluid concrete there seems no doubt that all cavities and seams adjacent to the tunnel section must be completely filled.

For pouring the floor and the main tunnel concrete a mixture of 1 cement to 4 of aggregate was used, all stones passing a ½-in. ring. The stone was kept small to avoid a possibility of choking the pipes. A fairly wet mix was used although nothing approaching sloppiness was required. Observation indicates that aggregate containing stone as large as 1-in. might be safely used in holes of 5½ or 6-in. diameter. Various devices were used to prevent any tendency to segregate the materials of the concrete, the most successful of which was a wooden box slightly larger than a standard nail keg fixed on top of the cast-iron pipe and directly underneath the pipe. The force of the concrete discharging into this box full of concrete gave the constituents a very thorough remixing. As a further precaution an inspector and two workmen were kept in the section being concreted, and properly distributed the concrete. These men were able to work in the concrete until it was within 3 ft. of the roof and it was at this stage the concrete dam or bulkhead was built on previously set concrete preparatory to the final or grouting operation. These men usually sank half way to the knees in the concrete, which will give some idea of the wetness of the mixture. Spouts with a hopper swiveled under the holes were also used successfully but were awkward to handle and seemed to involve more extreme effort than collecting in the box and then working along by shovel and tramping. The inspector had a field telephone installed in the tunnel giving ready communication with the mixer when instructions were necessary.

Filling Top Three Feet

The final stage was the filling of the space left as just described, the mixture used being 1 of cement to 3 of aggregate, the aggregate being in district parlance "rejected sand"; in other words, the excess finer materials screened from the pit run during the process of assembling the standard aggregate. This material was fairly well graded from a coarse sand to fine sand. As before indicated, this concrete was poured down the two outside holes of a three-hole set. A few batches quickly formed a cushion under the hole thus preventing segregation, as was easily proved by samples taken from the middle or observation hole.

The holes with one exception were bored directly on the centre line. This exception was at the eastern end where the rock was exceptionally seamy, and a couple of bad caves resulted. The second one developed an opening completely through the rock, letting in a considerable flood of water and earth from above; not, however, before the caving was visible on the surface 70 ft. above.

Some hesitation was felt about driving a hole through this shaky roof, and fortunately one of the large water worn cavities before mentioned was found here extending some 4 ft. off line of the tunnel. The pouring hole was accordingly driven here without the loosening of any further rock from the roof. Considerable water was coming through the roof in this section and was collected on a sheet-iron roof and run to wooden troughs along the side and carried beyond the concreting in progress.

For the final stage of pouring at this section, a 2-in. pipe was run through the concrete bulkhead and extended upward to near the upper surface of the rock, some 12 or 14 ft. above the roof line of the tunnel. When ready for concreting the wooden troughs were plugged and the compartment allowed to fill with water. When this was completed the concrete was poured into the still water down the pipe. Shortly after commencing the concreting, water began to discharge through the 2-in. pipe leading through the bulkhead. Finally grout began to appear discoloring the water; then the pipe was closed. Concrete was poured into this hole until it finally appeared in the cave-in previously mentioned above the centre of the tunnel.

Twenty-three holes in all were bored, the total cost of well boring, casings, temporary trestle over river and segregation prevention being less than $2.50 per cubic yard of concrete. Experience indicates that at least one-third of these holes might have been omitted. Where a 60-ft. head is obtainable the holes may be safely spaced at 80 ft. and with a certainty that all of the cavities will be thoroughly filled.—From "Enginering News-Record," New York.

PROTECTING IRON AND STEEL STANDPIPES FROM CORROSION

IN an attempt to bring together such information as may be obtainable, relative to actual experience with standpipe paints, Metcalf & Eddy, consulting engineers, of Boston, Mass., sent inquiries to water works in the northern and eastern parts of the United States where iron or steel standpipes are in use, requesting information as to the dates of painting, kind of paint used, preparation of the surface for painting, and other significant data. In general, the water works superintendents were generous with their responses, which were received during the winter of 1916-17, but in a disappointingly large number of cases the responses were, in effect—"The writer has been here but a short time. The former superintendent left no records and I do not know what paint was used or when it was applied."

The significant data received in response to this inquiry, together with some information available from other sources, were given in a paper read last week by C. W. Sherman, of the firm of Metcalf & Eddy, at the convention of the New England Water Works Association. Mr. Sherman's data cannot be summarized or averaged. In a few cases the standpipe had not been painted since erection. There are doubtless cases in which the quality of the water is such that it protects rather than corrodes the metal; such cases are, however, rare and experience seems to indicate that as a rule an iron or steel standpipe should be thoroughly cleaned and painted inside at least as often as once in four or five years, says Mr. Sherman. Perhaps, however, if the cleaning were as thorough as would be accomplished by means of the sand blast, and if a protective coating where then properly applied, the interval between paintings could be materially extended.

A. H. Kneen, of Philadelphia, painted two standpipes with vertical stripes of different kinds of paint, and observed the conditions after two or three years of service. The only paints which gave reasonably good service were a red oxide of iron paint, and red lead. Most of the paints used were undoubtedly proprietary articles, and although one red oxide of iron paint showed "good" or "very good" results, several others characterized the same way in Mr. Kneen's tabulation gave "bad" or "very bad" results. Red lead when used was employed only in the first coat, yet the results were characterized as "good" or "very good." It is not impossible, therefore, says Mr. Sherman, that two or three coats of red lead would have shown better protection than any of the other paints.

Practical Results Confirm Experiment

Mr. Kneen says: "Under the writer's supervision, we have had the inside of fifteen standpipes painted and repainted in the past seven years, the combined area of which is over 112,000 sq. ft., and the results obtained are similar to those obtained in the experimental tanks. Our conclusion to date is that paints having pitch or asphalt for a base, applied in this manner, are not suitable for iron in contact with water, but that two-coat work with a good quality of iron oxide or a paint with a good red lead base for the first coat, and an iron oxide paint for the second coat, if the iron is properly cleaned and the paint is properly applied, will protect the iron in contact with water for at least four years, unless the water is of unusual quality or the conditions are different than usually met with in water works practice."

The engineers of the Metropolitan Water Works (Boston) have adopted the policy of cleaning the steel by sand blast, and applying three coats of red lead to the interior surface of their steel standpipes. The following quotation from the fifteenth annual report of the Metropolitan Water and Sewerage Board describes the cleaning and painting of the Bellevue Hill standpipe:—

"On March 25th, the tank was taken out of service and drained, and the work of sand blasting and painting the steel was begun March 30th, by the W. L. Waples Co., of Boston, subconstractor for this work. The plant used consisted at first of a twenty horsepower gasoline-engine-driven air compressor, a compressed air reservoir, two lines of air hose and two nozzles. Sand blasting was stopped in the latter part of the afternoon of each day, and the cleaned surfaces were painted before rusting commenced. The force employed included one foreman, two painters, who also did sand blasting, and one helper. This force could sand blast and paint an area of about 330 sq. ft. per day. Later, in order to increase the rate of progress, a second compressor, operated by an automobile engine, was installed on April 19th. The entire inside and outside surface of the tank, having an area of 35,650 sq. ft., was sand blasted and painted. Work was completed June 14th, with the exception of the third coat on the outside, which has been deferred until after the masonry tower which encloses the tank in completed. All painting materials were furnished by the department, but were mixed by the contractor under the direction of the engineer. For the inside of the tank, National Lead Company's red lead in oil paste, litharge, and Spencer-Kellogg & Son's boiled linseed oil, were used; the first coat natural color, the second and third coats tinted with lampblack in oil. For the outside of the tank, red lead paste, raw linseed oil, and drier were used for the first coat, and for the second coat white lead, raw linseed oil, turpentine, and drier tinted with lampblack were used. One gallon of red lead paint was sufficient to cover 700 sq. ft. of surface with one coat. The subcontractor's price for sand blasting and painting the tank was $1,600. . . ."

Paint Immediately After Sand-Blasting

Mr. Sherman inclines to the opinion that the method just quoted represents the best practice of the present time. He would put especial emphasis on the thorough cleaning of the metal, and the *immediate* application of the paint to the cleaned metal before the latter has cooled and moisture has condensed upon it. The following quotation is pertinent in this connection:—

"Every specification for painting bristles with clauses prescribing what shall or shall not be done, and still the fact remains that there are more failures than even indifferent

successes, especially on work painted at the shops before shipment. The causes for the irregular and indifferent results are not difficult to ascertain. They are the improper application of the paint to dirty, greasy, moist or chilled, rusty or mill-scaled surfaces. No marked improvement in these uncertain results can be had until the same importance it attached to the 'paint question,' not only on paper, but in the actual supervision of the painting in all of its stages, as is given to the minutest construction details."

With regard to the coating to be applied to the metal after cleaning, it appears probable that not only red lead, but several of the graphite and red-oxide-of-iron paints, and perhaps certain enamel-like coatings, will give satisfactory protection.

10,000,000-GAL. RESERVOIR AT DAYTON

IN the year 1917-18, a covered masonry reservoir of 10 million gallons capacity was built for the water department of the city of Dayton, Ohio, to equalize the hourly fluctuations in water demand, to facilitate the making of minor repairs at the pumping station, and to provide fire service storage capacity corresponding to the 1916 standard of the National Board of Fire Underwriters. This reservoir was described by Leonard Metcalf and William T. Barnes, both of the firm of Metcalf and Eddy, of Boston, Mass., in a paper read last week at the convention of the New England Water Works Association. Following is Messrs. Metcalf and Barnes' summary of the points covered by their paper:—

The variation in rate of pumping at the main pumping station, to meet the demands of domestic, commercial and industrial water service, was from about 6 million to 35 million U.S. gallons per day. The storage required to equalize the hourly variations was approximately 3 million gallons, or 25% of the average daily water consumption.

The fire supply storage capacity required by the National Board of Fire Underwriters (1916 standard), corresponding to a ten-hour flow at maximum fire demand, was approximately 7 million gallons.

The sum of these two amounts (3 million and 7 million gallons) determined the capacity of the structure, which was reduced to the minimum on account of the difficulty and high cost of construction during war times.

The reservoir was built of concrete with walls of gravity section; inverted groined arch floor with 8-in. crown thickness; and 26-in. reinforced cylindrical concrete columns varying in length from about 20 ft. to 26 ft., supporting a flat-slab concrete roof 8⅜ ins. thick, reinforced with corrugated bars on the two-way system.

The original design prepared by the engineers for this work contemplated the construction of a groined arch floor and roof type of structure, with lighter walls than those finally used. This design was modified, however, on account of war conditions which made it impossible to secure outside bids and on account of the fact that the local bidders were more familiar with and better equipped to build the flat-slab roof construction and were therefore ready to submit relatively lower figures upon this type of construction than upon the groined arch structure. The unusual saving in cost here found justified the acceptance of a type of structure believed to have a somewhat smaller factor of safety and shorter life.

The total cost of the work to the contractor, excluding profit but including the cost of the materials furnished to him by the city, was $126,805, equivalent to $14.50 per cu. yd. of concrete, $12,680 per million gallons of net storage capacity, $2.08 per sq. ft. of net water surface, and $90,600 per acre of net water surface (the water surface being approximately 60,917 sq. ft., or 1.4 acres, and its depth averaging approximately 23.2 ft.).

The total cost to the city, including the land and engineering was approximately $153,041, equivalent to $17.50 per cu. yd. of concrete, $15,300 per million gallons of net water capacity, $2.51 per sq. ft. of water surface, and $109,300 per acre of water surface.

The character of the finished work was excellent, the concrete being dense and reasonably smooth.

The leakage of the finished structure was found to be $2\frac{5}{16}$ ins. vertically, or 88,000 gals. per day; and three months after putting the reservoir into service, 1¼ ins. vertically, or 48,000 gals. per day.

RECENT PUBLICATIONS

LIFE SAVING STATIONS.—An interesting folder calling attention to the fact that typhoid fever and similar intestinal diseases are caused by pollution of water supplies and that sterilization plants are really life saving stations, located not at the seaside but on reservoirs, streams and pipe lines. Issued by the Wallace & Tiernan Co., Inc., 349 Broadway, New York City.

WEBER CHIMNEYS.—Catalogue, 56 pages and cover, 5 by 9 ins., illustrating and describing reinforced concrete chimneys, including a number in Canada. The frontispiece is a photograph of what is claimed to be the highest chimney in the world, designed and erected by the company at Sagancseki, Japan; height 570 ft.; inside diameter at the top, 26 ft. 3 ins.

YARHOLA OIL PIPE LINES.—Description of the oil pipe lines of the Yarhola Pipe Line Co. extending from near Healdton, Oklahoma, to the Wood River Refinery, near St. Louis, Mo. This line is the property of the Roxana Petroleum Co., one of the producing companes of the Royal Dutch-Shell Co. The pipe line was designed and built by Sanderson & Porter, consulting and contracting engineers, New York, who are the publishers of the pamphlet. Illustrated; 18 pages and cover; 8½ by 11 ins.

JEFFREY STRAITFLO VENTILATORS.—Bulletin No. 270 of the Jeffrey Manufacturing Co., Montreal, P.Q., and Columbus, Ohio; 8 pages, 7½ by 10½ ins.; printed in two colors on coated paper, illustrated. This type of fan is equipped with a central disc about half the diameter of the wheel, on which is mounted blades designed so that the expulsion of the air will be the same at all points. It is used for drying or boosting purposes and also for removal of dust, heat and smoke from factories and other buildings.

ST. LAWRENCE RIVER POWER CO.—Interim order of the International Joint Commission in the matter of the application of the St. Lawrence River Power Co. for the approval of the construction and maintenance of a submerged weir in the south channel of the St. Lawrence river near the mouth of its power canal at Massena, N.Y.; 302 pages, folded maps and cover; 6 by 9 ins. The appendix comprises the larger portion of the book, presenting the detailed stenographic report of the evidence taken at the hearings.

HYDRAULIC TURBINE INSTALLATIONS.—New catalogue issued by the S. Morgan Smith Co., York, Pa., and Montreal, P.Q.; 64 pages and cover, 8½ by 11 ins., printed on coated paper in two colors and profusely illustrated. A number of views are shown of the company's various shops and foundries. A brief reference to the importance of runner and case design, and an explanation of type characteristic, together with efficiency contour charts, add to the reference value of the catalogue. The company's governor and pressure regulator are described, also the Gibbs oil thrust bearing, while the construction and erection of hydraulic turbines is described in considerable detail, illustrated by line drawings and half-tone views of numerous installations in Canada and the United States. The half-tones are beautifully printed and are typical of modern hydro-electric developments.

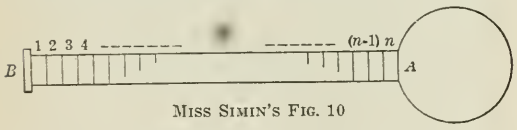
PRESSURES IN PENSTOCKS CAUSED BY THE GRADUAL CLOSING OF TURBINE GATES*

By Otto V. Kruse
Hydraulic Engineer, Larner-Johnson Valve & Engineering Co., Philadelphia, Pa.

THE writer has studied the phenomena of water-hammer, and offers a short analysis of Miss O. Simin's translation of Prof. Joukovsky's notable work, and an elaboration of certain parts of Mr. Gibson's paper.

Any pipe under pressure and containing water in motion may be assumed as a unit of energy under a condition of equilibrium. If we wish to stop the column of water, it means the application of a certain amount of force during a certain time to bring about the conversion of energy and restore the equilibrium. In analysing the phenomena which take place, the writer believes that the most important point to study is the rate of destruction of velocity as affected by the net head, because this determines to a large extent the rate of pressure rise and hence the maximum pressure rise. Apparently, Allievi used this as a basis for the development of his formula, and this, of course, applies to Johnson's formula, which is the same as Allievi's. Any formulas, such as Warren's and Vensano's, which do not take this into account, must be incorrect, except for one set of conditions. The curves given by Mr. Gibson show how far from the truth they may be.

In accordance with the ordinary methods of integration, it may be considered that the gate movement throughout the duration of the stroke is made up of an infinite number of small instantaneous movements. In the case of the formulas



Miss Simin's Fig. 10

of Allievi and Johnson, which involve the dynamic forces, each little movement of the gate produces a pressure:—

$$h = Ldv/gdt$$

The conditions existing, then, at the end of any small movement are:—

1. The original velocity has been decreased by the amount of the velocity destroyed during this first movement;
2. A dynamic pressure has been created due to the destruction of velocity.

A new velocity now exists, which is dependent, not on the original net head, but on a new head made up of the original net head and the dynamic head. As brought out by Mr. Johnson, these curves of dynamic pressure-rise and decrease in velocity may be calculated by a simple method of arithmetic integration, using only the relation, $h = Ldv/gdt$. The Allievi or Johnson formula will give a figure for maximum pressure rise, and Mr. Johnson has also developed a formula for the shape of the pressure curve, these formulas giving the same results as can be obtained approximately by arithmetic integration.

The question to be considered now is: To what extent, and how, do the compressibility of water and extension of the pipe walls affect the pressure and velocity curves? We know that, as the time of closing grows shorter, the Allievi formula approaches infinity. On the other hand, Joukovsky proved that the maximum pressure which obtained for instantaneous closing depended on the velocity destroyed and the speed of propagation of the pressure wave, and could not exceed "maximum water-hammer." It is not difficult to see that, for a long closing time, the compressibility of the water and extension of the pipe walls have very little effect on the maximum pressure, but, as the time of closing grows shorter, the properties of the materials have a greater and greater effect. The writer believes that Mr. Gibson's formulas have successfully supplied this missing gap between Allievi's and Joukovsky's theories, and serve to give correct results for all conditions.

Professor Joukovsky made a great many experiments to determine the magnitude of maximum water-hammer and the speed of propagation of the pressure wave, all based on instantaneous closing of the gates. The details of the experiments will not be given here, but the following is a synopsis of the theory, taken verbatim from Miss Simin's translation:—

"In Fig. 10, let $A\ B$ be a pipe, in which water flows with velocity, v, from the origin A, past the gate B. If, now, the flow is suddenly stopped by a rapid shutting of the gate, B, the kinetic energy of the water column, $A\ B$, will cause an increase of pressure in the pipe.

"Let us consider the column of water, $A\ B$, as divided into n very small equal sections, 1, 2, 3,.... $(n-1)$ and n.

"The phenomena of water-hammer take place in a series of cycles, each consisting of four processes, as follows:—

"(1) Section 1, meeting, in the gate, an obstacle to its movement, will be compressed and will stretch the pipe wall surrounding it. All the kinetic energy of this section of water will be used up (a) in its own compression, resulting in the increase of pressure by an increment, P, and (b) in the corresponding stretching of the walls in section 1 of the pipe. As a result of this action, section 1 of the water column has left vacant behind itself a small space, to be occupied by a part of the next arriving section 2. Consequently, it is only after section 1 has been stopped and compressed, and after the small space thus left has been filled, that section 2 can be arrested and compressed.

"Now the kinetic energy of section 2 must be expended in some way. Will it increase the pressure upon the gate, which has already been caused by the arrest of section 1? No, and for the following reason:—

"The pressure upon the gate depends entirely upon the pressure, P, sustained by section 1, which is now in static condition.

"The pressure upon the gate could therefore be increased only if section 1 could be farther compressed, and this could take place only if the pressure upon the surface between it and section 2 (which we may imagine to be a thin piston) could be greater from the side of section 2 than it is from the side of section 1; and this is impossible, because section 2 has only the same kinetic energy as section 1, and this energy will (as in the case of section 1) be used up entirely in compressing the water of the section (section 2) only to the same additional pressure, P, and in stretching that part of the walls surrounding section 2.

"The same is true of each following section, 3, 4,.... $(n-1)$ and n; each of these sections, as it is arrested, being compressed to pressure, P.

"During process (1) a small quantity of water flows from the reservoir into the pipe, to occupy the space formed by the compression of the water and the extension of the pipe walls.

"Finally, when all the sections have been arrested, the entire column will be under the pressure, P. The entire energy of the water column is now stored (as potential energy) in elastic deformation—viz., in the compression of the water column and in the extension of the pipe walls.

"But this condition cannot be maintained; for

"(2) As soon as the additional pressure, P, has been produced in the last section, n, the water in that section will again expand, and the walls of that section of the pipe will again contract, restoring the original conditions in that section, and pushing the water of that section back into the reservoir from which the pipe issues, and restoring the original normal pressure in section n.

"The operation will now be repeated by each section $(n-1)$,....4, 3, etc., in turn, until all the potential energy, stored in the water column when it was under the pressure, P (neglecting the portion lost in friction), has been reconverted into kinetic energy.

"During process (2) the water which entered the pipe during process (1) is forced back into the reservoir.

*Discussion (presented to the American Society of Civil Engineers) of Norman R. Gibson's paper (see September 4th and 11th issues of *The Canadian Engineer*).

"The condition of the water column is now what it was just before the gate was closed, except that its velocity, v, has now the opposite direction—i.e., toward the origin.

"(3) The kinetic energy of the water column, moving toward the origin or away from the gate, is now reconverted into potential energy, which manifests itself in an extension of volume of the water to a subnormal pressure beginning with section 1, and concluding only when the entire water column has been reduced to the subnormal pressure.

"During process (3) water continues flowing from the pipe into the reservoir.

"(4) When the subnormal pressure has been established throughout the length of the pipe, and all the water has come to rest, the water from the reservoir will again direct itself into the pipe, restoring the normal pressure, first in section n, next to the reservoir, and then, in rapid succession, in the other sections $(n-1),\ldots.4, 3$, etc., until, when the normal pressure reaches the gate, we have once more the conditions which existed just before the gate was closed—viz., the normal pressure is restored and the water is moving toward the gate with the original velocity, v.

"We have now followed these pulsations of pressure (with the accompanying transformations of energy and flow of water into and back from the pipe) through a complete cycle of four movements, each extending through the length of the pipe. For convenience, we may consider two successive movements of this kind as a 'round trip' through the pipe.

"The gate remaining closed, the whole process is now repeated in a second cycle, which, in turn, is followed by a third, and so on, the amplitude of the pressure vibrations gradually diminishing (because of friction) until the pipe and the water come to a state of rest.

"But although the intensity of the pressure becomes gradually less, the time required for each cycle remains constant for all repetitions.

"This propagation of pressure, consisting of its transmission through all points of the length of the pipe, each point successively repeating the same periodical movements is, in its nature, simply a case of wave motion, like that of a sound wave.

"The velocity of wave propagation is independent of the intensity of the pressure, and depends only upon the properties of the medium through which the propagation takes place—in the case of water-hammer, upon the elasticity of the water and of the pipe."

Mr. Gibson has applied this theory to slow-closing gates by considering that each infinitesimal movement of the gate is instantaneous and produces a small rise of pressure which travels through the penstock in the same manner that a wave produced by total instantaneous closing would travel. These small gate movements occur in succession and produce in turn their pressure waves which travel back and forth through the penstock. An algebraic sum of these waves gives the rise of pressure existing at any time during the closing stroke.

The writer is of the opinion that the pressure existing throughout the length of the pipe for a slow-closing gate varies almost directly from a maximum at the gate to zero at the point of relief, except where the time of closing is less than $2L/a$.

In Fig. 11, the pressure existing at four points on the penstock has been plotted. The magnitude of the individual pressure waves is not to scale, but their values are shown for the particular example taken. The pressure existing at a point $L/2$ from the gate is approximately one-half the pressure existing at the gate. The pressure existing at a point $3L/4$ from the gate is approximately one-quarter of the pressure existing at the gate.

The diagram showing the pressure existing at the point of relief consists of a series of instantaneous rises above normal. On account of the assumption of twelve instantaneous movements of the gate, the pressure at the point of relief must of necessity show twelve instantaneous rises of pressure, as each wave travels undiminished to the point of relief. If twenty-four instantaneous movements were chosen, there would appear twenty-four instantaneous rises of pressure in the same time, but of only about half the magnitude. Hence, in the limit of an infinite number of instantaneous movements of the gate, or uniform slow-closing, the pressure at the point of relief becomes zero. This must be true, because the duration of time of any rise of pressure at the point of relief is zero. Wherever rises of pressure have actually been recorded at the point of relief on a penstock, they are probably due to an instantaneous movement of the gate during the stroke, or to some other cause, such as a sudden elastic deformation of the waterway, which would have the same effect.

In the translation of Professor Joukovsky's work there are shown tables of pressure rises at different points on the pipes for different velocities destroyed. In every case the pressure waves travel practically undiminished almost to the point of relief. The readings taken at the station nearest the point of relief, however, show a reduction in pressure of from 60% to 80%. This is very significant to the writer, as an indication that the pressure travelled undiminished to a certain point and then gradually was reduced to zero at the point of relief. Although Professor Joukovsky experimented with very rapidly closing gates, as nearly instantaneous as possible, obviously a certain fraction of a second must elapse while the gate is closing. When the time of closing is less than one interval, $2L/a$, the resultant pressure will travel undiminished to a point which is $Ta/2$, in feet, from the

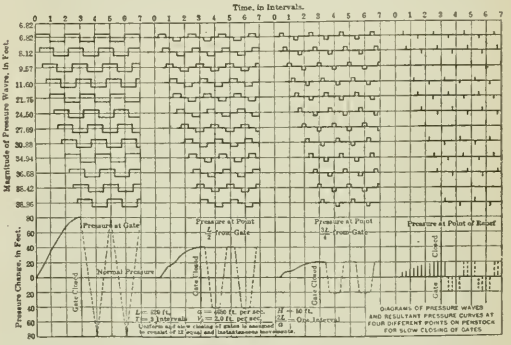

Time, in Intervals.
Magnitude of Pressure Waves, in Feet.
Pressure Changes, in Feet.
Pressure at Gate
Pressure at Point 1/2 From Gate
Pressure at Point 1/4 From Gate
Pressure at Point of Relief
Normal Pressure
Gate Closed
DIAGRAMS OF PRESSURE WAVES AND RESULTANT PRESSURE CURVES AT FOUR DIFFERENT POINTS ON PENSTOCK FOR SLOW CLOSING OF GATES

FIG. 11—PRESSURE AT FOUR POINTS ON PENSTOCK

point of relief (where T is equal to the closing time, in seconds). From this point it will gradually be reduced to zero at the point of relief. Granting that some short period of time must elapse during the closing of the gates in Professor Joukovsky's experiments, his actual pressure readings seem to verify the writer's claim.

In the example taken, the duration of closure is assumed to be three intervals. The diagrams and curves have been plotted beyond the three intervals to show the fluctuations of pressure which take place after the gates are closed. Experiments should show that the subsequent fluctuations after the gates are closed are quickly reduced in intensity by internal friction, but this friction should have no effect on the speed of propagation of the pressure waves. Internal friction has of necessity been omitted in these computations, as it is an unknown quantity.

Any other example than that shown by Fig. 11 may be chosen, and the pressure waves may be computed by Mr. Gibson's formulas. A series of diagrams may then be plotted, similar to those shown by the writer, and the pressures may be computed for any point on the penstock.

In making the computations for the magnitude of the pressure waves, it is necessary to determine first the number of intervals of time (equal to $2L/a$) contained in the total closing time. The gate movement may then be divided into a number of instantaneous movements equal to the number of intervals. Computations carried out on this basis will give correct points on the pressure-rise curve at the end of each interval. In the event of the closing time being only a few intervals, it is desirable to subdivide the gate movement further in order to develop the curve during the in-

tervals. It is an interesting fact, however, that such further subdivision of gate movement serves only to develop the shape of the curve during the intervals, and has no effect on the values at the end of each interval. In making studies of this character, it is often easier instead of using Mr. Gibson's formulas, to utilize the system of arithmetic integration, which will give correct results, although involving trial-and-error methods.

In order to compute the pressure-rise curve at points on the penstock other than at the gate, the gate movement must be divided into a number of divisions sufficient to cause the pressure waves to overlap. Thus, at least two divisions per interval must be used to compute the curve at a point half way up the penstock, at least four divisions per interval for a point three-quarters of the way up the penstock, and at least eight divisions per interval for a point seven-eighths of the way up the penstock. Referring to Fig. 11, where four divisions per interval were chosen, it is obvious that the pressure beyond the point, $3L/4$ from the gate, cannot be computed without a greater subdivision of the gate movement.

In this discussion the writer has endeavored, principally, to point out the trend of argument and application of existing data used in proving the theoretic correctness of Mr. Gibson's method of handling water-hammer problems. The method seems to be fundamentally sound, and deserves the careful thought of engineers.

PROPOSED TIDAL POWER DEVELOPMENT AT HOPEWELL

(Continued from page 366)

up the matter of borings with the provincial government very urgently last winter, but I was met at first with promises, and later with apathy, and I regret I could not undertake the expense of the matter personally. This summer I went twice to Hopewell, but could only obtain indirect evidence as to the depth of the rock under the muddy beds of the two rivers. The full line of the profile shows the depth of the top of the mud according to the admiralty chart, and there is strong presumptive evidence that the top of the rock does not lie more than 15 to 20 ft. below this. Where the "new wharf" was built at Hopewell, the mud soon washed out for a depth of 12 ft., when hard bottom was reached, and the outcropping of ledge rock at the mouth of the Memramcook indicates that rock bottom for a quarter of a mile is very near the surface. The shores at Hopewell, Fort Folly Point and Cole's Head are all rocky, and the nature of all rock in this locality is the same, viz., shaley sandstone to pure sandstone, sufficiently sound for making grindstones.

As to the best type of dam to build at Hopewell, I feel that I should offer no opinion, for the question of dam design is an engineering specialty and only an expert in this particular branch of engineering could decide the best type to adopt, and he only after a systematic line of borings were obtained along the proposed site. It has been suggested to me that a dam composed of hollow sections of concrete is a satisfactory and cheap type to build, the sections being built in a dry dock, floated into position and then sunk by filling the interior with rock and gravel. However, I doubt if this is a well proven system and, as I say, the question of best type should be decided by an expert of long experience.

Such estimates of cost that I have been able to make have been based on the cyclopean concrete type of dam. In considering the best type to build at Hopewell, the question of the tidal currents would have to be considered, and while these currents are not very swift, when the great height of the tide is considered, nevertheless they should receive attention. Fig. 4 shows some current measurements that I made this summer by using a ship's log attached to an anchored boat. When the tidal range was 38 ft., the channel current reached a maximum of 4.2 knots and you will note that although the flood current soon dies out, the ebb persists at near its maximum until almost the time for the next flood tide to begin. Out of the channel the current runs swiftly for much shorter periods, and the tidal current makes shoreward as the shores are approached, until we often have currents at right angles to the main stream. The dotted curve shows some measurements taken rather off the channel, with a tidal range of 28 ft., and the maximum under these conditions was 2.6 knots.

Before leaving the engineering problems that are presented by this novel plant, I will refer to three other items that should be considered.

The question of subnormal neap tides requires especial attention, for while my calculations are based on the least range, viz., 32 ft., of ordinary neap tides, nevertheless there are certain tides which occur sometimes three days a month, sometimes five days a month, and sometimes not at all in a month, which have a lower range than 32 ft., and may sometimes have a range as low as 24 to 25 ft.

Subnormal Neap Tides

Now, if our plant were built and running at full capacity, with a range of 32 ft., there would be an impairment of the regular capacity whenever these subnormal neaps occurred (which is about 15% of the time), and I think some provisions should be made to deal with them adequately.

One method might be to keep the turbines and generators well ahead of the normal demand and use these extra ones only during the subnormal neaps. Another method would be to keep the Memramcook shovelled out (as already described) well ahead of the regular requirements, and thus improve the average head. Yet another method would be to build a freshwater dam (say just below Turtle creek, about 5 miles west of Moncton) in which freshwater would be impounded and released only to make up the deficiency in head at subnormal neaps. Still another method would be to employ auxiliary steam power to assist the water-power during the water deficiency. One of the last two devices is nearly always resorted to in the case of ordinary hydro-electric plants situated on fresh water rivers. In nearly all districts the amount of rainfall varies enormously during the different months of the year, and the amount of run-off and discharge varies in a direct relation to the rainfall. As an example of this, the discharge at Grand Falls on the St. John river reached a maximum in May, 1909, 50 times greater than the maximum of October, 1900, and the mean discharge for the whole month of May was 20 times greater than the mean for October. In fresh water rivers a certain power may run into thousands of hosepower in the spring, but be reduced to hundreds in the fall of the year unless adequate means are resorted to in order to increase the deficiency of head.

In this matter, a tidal power scores heavily over a freshwater power. In the case of the freshwater power, neither the time nor quantity of head deficiency can be predicted, but with a tidal power, both the amount and the deficiency are predicted by the tide tables several years in advance, and it will thus be much easier to provide for our head deficiency, which only, after all, amounts to 25% in quantity and occurs only 15% of the total time.

The best means of making up the deficit in the case of the Hopewell Tidal plant would be best figured out in the final estimates as that one which would maintain the normal output at a minimum of cost.

Sediment and Ice

The two other remaining engineering items are sediment and ice. At present the never-ceasing current flows up and down the two rivers, keeps the river mud stirred up, and the water of both rivers shows a considerable amount of sediment, and one would at first jump to the conclusion that this muddy grit (fine though it is) would produce much unusual wear on the turbines. However, what will happen as soon as the mouth of the Petitcodiac is closed by a dam? The mud in the water above the dam will undoubtedly settle, for it will have time to do so, and the water of the Petitcodiac will become clear. At present the water is never still, but with a dam, the rise and fall would be reduced to a few feet and the current would be sluggish.

In a similar way, the building of the dam would entirely alter the ice conditions. Once the dam was built, the whole

river would freeze over in severe weather, and the sheet of ice would rise and fall with the water just as it does in the St. John and similar rivers. Nevertheless, while the building of the dam was in progress, the question of large masses of ice moving with the current should be given every attention, and quite likely some special method of cushioning the blows from ice might have to be devised.

Considering the method of distributing the power available at Hopewell, Fig. 7, shows how centrally Hopewell is placed with reference to the centres of population of both New Brunswick and Nova Scotia.

The method of transmission carries with it no special problems, as we would undoubtedly use step-up transformers at the power house, transmit at about 30,000 volts with 3-phase current, and use step-down transformers at the delivery points. All this system has been so thoroughly thrashed out, and is in daily use all over Canada and under Canadian winter conditions, that it has become practically standard and needs no special consideration here.

Population and Power Requirements

The principal feature that should be considered in laying out the transmission lines would be one of expediency and proper return on the capital outlay of transmission lines and line losses. Undoubtedly, a main line should go west to St. John, with power for all intervening towns and villages of any size, and undoubtedly a main line should go east and south to Halifax with power for Sackville, Springhill, Amherst, Truro, etc., and also branch lines should go to Moncton, New Glasgow and Stellarton, as the present population would warrant this. The extension of branch lines to St. Stephen, Fredericton, Newcastle and Chatham is somewhat doubtful at present, but there are railways that well might be economically electrified toward all these points, and I have therefore included them in the preliminary estimate. I have prepared a table of the population that would be served by these lines, and the total works out at 250,000 inhabitants. With this as a basis we should now estimate the probable per capita use and thus obtain an estimate of the proper size of plant for the initial development at Hopewell.

When I prepared my first report on this subject, it was submitted to the well-known firm of Sanderson & Porter, of New York, a firm who specialize in the control and management of some 60 hydro-electric developments, and their condensed criticism was as follows:—

"We think your proposal from an engineering standpoint is sound and it is the only scheme for utilizing tidal power that seems practical, but we are rather in doubt as to whether the population served is sufficiently large to warrant the capital expenditure."

Now this was in 1914, and I presume Sanderson & Porter based their opinion on the per capita use of hydro-electric power in the United States, which works out at 0.10 h.p. per inhabitant, according to their text books. On this early report, and on their opinion, I based the letters to the newspapers that were published in St. John and Halifax, and in these letters I appealed for governmental help, since it seemed at that time that while my proposal was almost a commercial one, it was not conclusively so.

0.36 H.P. per Capita

Since last January, however, newer data has come to hand, and this data is accurate, as I presume it is, the complexion of affairs has changed and the Hopewell plant is really a good commercial proposition at the present time, and needs only the governmental help accorded by a good charter.

The data that I speak of shows the per capita use of hydro-electric power for every province of Canada and for the Dominion as a whole. It shows that British Columbia uses 0.36 h.p. per capita, Ontario 0.288, Quebec 0.267, and the whole of Canada 0.206 h.p., and these figures are for the total population and they should be increased at least 30% for the per capita use of population served. It will thus be seen that Ontario, per capita served, is using about 0.37 h.p. and Quebec about 0.35 h.p., and I think we may properly assume that 0.36 h.p. would be used by the inhabitant of the Maritime Provinces as soon as he is given really cheap electricity.

On this basis, then, the population of 250,000 would require 90,000 gross horse-power, or, say, 45,000 h.p. at the delivery points, and I think the initial development at Hopewell should be for 90,000 h.p., with every provision made for increasing the output, as already outlined in this paper, up to 200,000 gross horse-power as the population and demand increased, as they undoubtedly would when cheap power was available.

Cost of Initial Development

Turning to the question of costs, I have made an estimate of this as follows, and in accordance with the text books on the subject:—

DAM COST IN CYCLOPEAN CONCRETE

Western Dam.	
730 lineal feet at equivalent height of 38 ft. and $137 per lineal foot	$ 97,000
4,100 lineal feet at equivalent height of 65 ft. and $300 per lineal foot	1,230,000
Eastern Dam.	
2,800 lineal feet at equivalent height of 65 ft. and $300 per lineal foot	840,000
2,000 lineal feet at equivalent height of 35 ft. and $120 per lineal foot	240,000
Wing Dam.	
900 lineal feet at equivalent height of 30 ft. and $94 per lineal foot	84,600
10,530 ft. Total cost,	$2,491,600

One well-known engineer who examined my first report, considered this too low a figure and thought $4,000,000 should be allowed for dams, and since we will remain uncertain about the dam cost, until borings are made, it will be best to allow this higher figure in the preliminary estimates.

The other items of cost can be more accurately estimated from the known cost of equipment in existing hydro-electric developments, and we have the following table of total estimated cost:—

Dams	$ 4,000,000
Lock in western dam	100,000
Sluices, gates, etc.	300,000
Power house of steel and concrete	200,000
Turbines, generators, etc., at $40 per gross h.p.	3,600,000
Transmission lines, etc.,	1,200,000
Preliminary dredging, dam, trench, etc.	100,000
Promotion, engineering fees, etc.	500,000
Auxiliary plant to supply head deficiency at sub-normal neap tides, say	1,000,000
Total cost of initial development to produce 90,000 gross h.p.	$11,000,000
Or cost per h.p. developed	$ 122.50

Cost of Subsequent Enlargement

The cost for subsequent development is much less, relatively, for in the initial development full allowance has had to be made for the final development in all items except turbines, generators and transmission lines, and the cost of a full development of 200,000 gross h.p. would work out at about $16,000,000, or $80 per gross h.p. In this estimate for final development, the cost of shovelling and dredging the Memramcook farming lands (which would be necessary as previously shown) is not figured, for it would be undoubtedly good policy to start this work as soon as the power house was in operation, and take the necessary cost out of the annual income.

In considering the charge that could probably be made to the consumer initially, we must consider the cost of steam power to the provinces, and I have it on good authority that the actual cost to the largest producers of electricity, by steam, was $60 per h.p.-year before the war, and would be about $90 per h.p.-year at the present time.

Suppose, now, we were to charge half this rate on the average, and place our charge at $45 per h.p.-year, this would

be the average charge and the charge in special cases would work out about as follows:—

	Charge per k.w.h.
(1) To power users in excess of 1,000 k.w.h. per month and 24-hr. service	0.75c.
(2) To power users, in excess of 1,000 k.w.h. per month, and 10-hr. service	1.5 c.
(3) To small power users and 10-hr. a day service	2.25c.
(4) To power users, irregular service	3.0 c.
(5) To small lighting service	4.0 c.

These rates are from one-quarter to one-tenth the rates now charged in the Maritime Provinces. They would attract population and develop industries, and they could be gradually reduced, as the demand for greater output increased the size of the plant, to about 60% of these rates.

On this basis, then, the annual income should be $2,025,000 initially, and this would probably be apportioned about as follows:—

Depreciation and operating expenses at 60% on cost	$ 660,000
Royalty on patent rights at 50 cents per gross h.p. produced	45,000
Enlarging Memramcook valley by shovelling and dredging, the power being supplied by the plant itself, say	200,000
Incidentals	20,000
Interest on capital expenditure at 10% of cost	1,100,000
Total	$2,025,000

While $45 per h.p.-year would probably have to be the initial average charge, as time goes on and the output increases to the full available horse-power, it would be quite possible to reduce the average charge per horse-power-year to $27, without decreasing the rate of 10% per annum on invested capital. This is figured as before, as follows:—

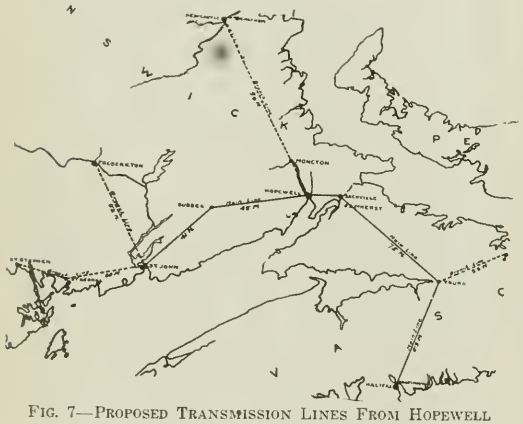


FIG. 7—PROPOSED TRANSMISSION LINES FROM HOPEWELL

For gross output of 200,000 h.p., delivered h.p. 100,000, cost of development	$16,000,000
Annual income from 100,000 h.p. at $27 per h.p.-year	2,700,000
This income is apportioned as follows:—	
Depreciation and operating expenses at 6% on cost	$ 960,000
Royalty on patent rights at 50% per gross h.p. produced	100,000
Enlarging Memramcook valley, nil, since work would by this time be completed	.....
Incidentals	40,000
Interest on capital expenditure at 10% on cost	1,600,000
Total	$2,700,000

The Commission of Conservation's book on the "Water-Powers of Canada" (1911) says, in speaking of New Brunswick, that "the larger rivers, for the most part, are long and their fall is gradual"; and again, that "there are comparatively few lakes in the upper portions of the watersheds of the majority of the rivers and, hence, little facility is afforded for the natural storage of waters for the purpose of equalizing the flow during the low-water periods."

This is true of New Brunswick and it is also true of Nova Scotia. The upper provinces are steadily forging ahead of us, both industrially and in population, and this advance can be ascribed largely to their abundant water-powers, and it behooves us of the lower provinces not to mourn our loss of power, but to make full use of that great power that nature has really placed at our door—viz., the Bay of Fundy tides.

Were we to harness the power that is daily wasted in the two great eastern arms of this bay, we could have the use of 3,500,000 h.p., but this is a dream for the future and is not a practical proposition for to-day. The theory is the same as for the Hopewell plant, but the execution and cost would be impossible at present.

The Hopewell plant is to-day a good commercial proposition. Special engineering problems are attached to it, but they are only those that attach to any special plant. The difficulties are small in comparison to many recent engineering works that have been successful.

NEW ENGLAND WATER WORKS CONVENTION

MEMBERS of the New England Water Works Association met in Albany, N.Y., last week for their 38th annual convention, which occupied the four days, September 30th to October 3rd, inclusive. They were welcomed to Albany by that city's chief executive, Hon. James R. Watt, who is an engineer and contractor.

The presidential address of Samuel E. Killam laid stress upon the opportunities that exist for the association to exert a helpful influence in public affairs. Particular vigilance is needed, he said, in the matter of legislation affecting public health, and in each state a committee should be appointed to examine proposed legislation of this nature.

Over 300 members, associate members and guests were at the convention. The sessions were all well attended, and much interesting discussion followed the papers. The list of papers presented was published in *The Canadian Engineer*, September 25th issue.

The only paper on Canadian work was by Norman J. Howard, who described the construction and operation of Toronto's drifting sand filtration plant. This paper was discussed in a lively manner for more than an hour. James M. Caird, consulting chemist, took a leading part in the discussion. Mr. Caird particularly inquired regarding costs of operation and the ability of the plant to prevent the passage of alum into the filtered water.

Mr. Howard stated that cost figures are not yet available. As to the alum, he reported the presence of aluminum hydrate in the filtered water, but claimed that its presence is not significant, and that so far as he has been able to ascertain, it can be found in the effluent of all mechanical filtration plants, and that it is entirely harmless and inert.

Mr. Caird differed with Mr. Howard in this regard, but several of the consulting engineers and water works superintendents who were present supported Mr. Howard's statements, and considerable difference of opinion was expressed in regard to the point.

Morris Knowles characterized the Toronto plant as a radical departure in water works purification practice, and said that engineers are awaiting with great interest further detailed data on filtration costs.

All of the members and guests assembled on a Hudson River Line steamer on Wednesday, October 1st, and spent the entire day on the steamer, holding sessions during a trip down the river.

A number of the engineers enjoyed an automobile trip Thursday morning to the Gurley factory at Troy, where the Gurley long-distance water recorder was seen in actual operation.

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PROPORTIONING OF CONCRETE MATERIALS

ENGINEERS and scientific investigators are delving deep in an effort to discover the fundamentals underlying the assembling and combining of the component materials of concrete; the relation of each of these materials to the strength and other physical properties of the final mass; and the effect of various conditions of placing, curing, etc., tending to influence the permanence of structures in which concrete is used.

The old adage that there is an adequate cause for every effect, and, conversely, an effect for every possible combination or condition, holds especially true of concrete. From the investigations to determine the why and how of all things pertaining to the subject, we have learned that concrete is not a complicated material but that far more care must be exercised in its use than we believed to be the case only a few years ago.

It has been proved that some of the practices now in common use are productive of very widely varying results. Of these, the arbitrary proportioning of the cement and aggregates by gross volumes is now claimed to be especially unscientific.

In this issue is published a discussion, by L. N. Edwards, formerly supervising engineer of bridges of the city of Toronto, of the paper, "Studies in Surface Area Proportioning Method," by R. B. Young, assistant laboratory engineer of the Hydro-Electric Power Commission of Ontario. Mr. Young's paper was first published in our issue of June 26th, 1919.

In the laboratory testing of concrete and concrete materials, no detail is of greater importance than that of securing a uniformly strong cement matrix binding together the particles of the sand and stone aggregates. In specifications for concrete construction work, no detail has been described so indefinitely. No ingredient of the mix performs a more important role than does the water content. It is, therefore, of special interest to note that Mr. Edwards strongly advocates the use, in both laboratory and field, of a method whereby the quantity of water to be used in the mix is mathematically determined. In this connection, it is his contention that the property commonly termed workability, flowability or plasticity, is a secondary factor rather than a primary one, and that it is largely dependent upon the character of the aggregates and the richness of the concrete mix.

In the issue of May 15th, 1919, we published an article, "Bulking Effect of Moisture in Sands," written by Mr. Edwards and containing a part of the results obtained from his tests which were at that time in progress. The more complete information secured from these tests, and more especially the relation existing between the area-water content and the bulking effect, described fully in his discussion of Mr. Young's paper, is well worth serious study, inasmuch as this bulking effect of moisture in sands may have some bearing upon the consistency formula proposed for use in testing concrete and concrete materials.

OUR GREATEST NATIONAL MENACE

IN past issues we have frequently referred to the seriousness of Canada's fuel problem. In this connection, in last week's issue, there was published the clearly expressed and statesmanlike address delivered by Arthur V. White, consulting engineer of the Commission of Conservation, at the annual meeting of the Canadian Gas Association. In view of the industrial and economic situation in Canada, we unreservedly agree with Mr. White in his statement that "whether conditions of curtailed fuel supply for Canada be delayed from materializing this coming winter or next winter, or until some time in the future, nevertheless I am firmly convinced that there is no menace to Canada's economic and general welfare at all comparable to the fact that she is at present so largely dependent upon a foreign country for her fuel needs. Without this foreign supply, Canada most assuredly would be put to desperate straits."

In other articles by Mr. White and many other writers, statistics have been given relating to the coal, oil and water power resources of the Dominion. The extent of the development of these resources has been shown; and the lines along which further development and conservation must be expected, have been indicated. If these various phases of the subject are not co-ordinated by some agency sufficiently powerful to take the fuel problem seriously in hand, such as a federal ministry of fuel, we may some day have "Fuelless Months" instead of "Fuelless Mondays."

It is idle to talk about the great natural resources of Canada unless those resources are to be actively developed. As Mr. White says:—"I shall not dwell on these enormous reserves. It seems out of place to emphasize how much we have latent when alongside of it we are not able to show how beneficially these assets are being used both for our own support and for the assistance of other needy nations. When the population of the prairie provinces are insured against yearly fuel shortage, we shall be more interested in hearing emphasis laid upon the enormous fuel reserves of these provinces; and when Canada produces more than her present amount of 2 per cent. of her total annual oil consumption, we shall be more interested in hearing emphasis placed upon the statement that we have the biggest oil fields in the world."

Canada's only sane policy is to develop as rapidly as possible both her fuel and power resources, and by co-ordination of transportation and other cognate agencies, to provide for the distribution and storage of fuel in all communities of the Dominion. As Mr. White says, in some respects it is more important to move coal and have it adequately stored and distributed throughout Canada, than it is to remove grain out of the country.

PERSONALS

Carleton Emerson Davis, who will preside at the convention of the American Water Works Association to be held next summer in Montreal, Que., is chief of the Bureau of Water, Philadelphia, Pa. He graduated in 1893 at the Massachusetts Institute of Technology. After graduation he was assistant engineer at Manchester, N. H., for one year, and then spent four years as assistant engineer on the construction of extensions to the water works at New Bedford, Mass. After several years as resident engineer on the construction of additional water facilities for Newark, N. J., Mr. Davis was chosen as engineer in charge of water works, sewers and municipal engineering for the Isthmian Canal Commission, Panama. In 1905, he was engaged by J. Waldo Smith, chief engineer of the Board of Water Supply, New York City, as head of the reservoir department in that city, which position he occupied until 1912, when he resigned to accept his present post at Philadelphia, which includes operation and maintenance as well as the assessment of revenues aggregating $5,500,000 per annum. Mr. Davis has also charge of all extensions and improvements to the Philadelphia water works. He was elected president of the American Water Works Association last June at the meeting held in Buffalo, N.Y. For the past twenty years he has been a member of the American Society of Civil Engineers.

A. Frank Wickson, of Toronto, has been elected president of the Royal Architectural Institute of Canada for the next twelve months. Alcide Chausse, of Montreal, was re-elected as honorary secretary.

C. D. Harrington has been appointed vice-president and manager of Anglin-Norcross, Ltd., a recent amalgamation of two large construction companies in Montreal. Mr. Harrington is an engineering graduate of McGill University.

H. T. Routly, construction engineer of the Ontario Department of Highways, has resigned. It is stated that Mr. Routly tendered his resignation last July, but it was not accepted until October 1st. The duties of his office are being apportioned among the other members of the department's staff.

Letter to the Editor

QUANTITY SURVEYS vs. "PAYMENT"

Sir,—I notice in your issue of September 18th, an article outlining the "Kelley System" of payment to contractors for estimating. I have studied the so-called "Nelson" and "Kelley" plans, and although I may be somewhat dull, I cannot for the life of me understand how either plan could be proposed to take the place of the quantity surveyor.

At the present time, engineers and contractors are trying to get away from conditions that they recognize are unfavorable both to the profession and to the owners who have to pay for the work. The cost of living has in some way to be brought down from its present high level, and, owing to the high wages existing, it seems to me that the only way in which we can reduce the cost of building is to eliminate so far as possible these bad conditions,—eliminate the unnecessary duplication of our work and create efficiency in every department.

Following this argument it seems that the first bad feature to be eliminated is the taking off of quantities by each contractor and having this done by a competent man who specializes in this work, issuing plans, specifications and bills of quantities complete to each contractor tendering.

By introducing the quantity surveyor, every contractor figures on the same bill of quantities. We thereby eliminate the excessive cost of taking off the quantities by having *one man do the work once*, and not a dozen times or more according to the number of contractors figuring. It is very easy to be seen that every contractor figures (in his overhead charges) the cost of taking off quantities and estimating work which he never obtains. Therefore, those who pay for the work executed, also pay for the work which the contractor has done on other tenders of which he did not receive the contract. So, by introducing the quantity surveyor, we eliminate the duplication of work, and also lower the cost of such work to the owners.

Why should Mr. Kelley receive 7½% commission from the contractors? Why should the local agent receive 7½% commission? It seems to me that this system is what might be called, in somewhat slangy language, a "skin game," and, as far as I can see, would by no means tend to raise the status of the contractors in the estimation of the engineers and owners.

In the past many people have looked upon a contractor as almost a crook, and it is undoubtedly a fact that many men who are to-day in the contracting business are better equipped for other spheres of operation rather than the contracting business, and it seems to me that this so-called "Kelley" system would bring into operation many more men of that description.

The contracting business to-day is every bit as much of a profession as is engineering, and it is up to the contractors and engineers to wake up and put themselves in a position where they can claim the respect and admiration of the community. This cannot be attained by any easy-money scheme, such as the "Kelley" plan, to my mind, is liable to become.

The article in question makes no distinction between "taking off the quantities" and the "estimate of cost." We cannot eliminate the cost to the contractor of *estimating*, for he is the only man who can estimate the cost of his work, and this is absolutely a part of his business.

Quantity surveying, however, is a very intricate and necessary branch of the civil engineering profession, and we all know that work done by a man who specializes in any particular line is far better than that done by a "Jack-of-all-trades."

The whole of the questions in the "questionnaire" seem to point to the fact that the whole system is designed as a method of getting easy money and should not be recognized by any contractor, engineer or architect, it being detrimental to the profession in every way.

We can go just as far as we like along the lines of the "Nelson" and "Kelley" plans and never get anywhere but in bad repute with the public. Each plan proposes payment of money for work done which *is absolutely unnecessary work*, and the sooner we come to recognize the fact that the quantity surveyor is absolutely the one and only answer to the question, the the better it will be for the profession.

I think that all those in the engineering and architectural professions will soon see that it is to their advantage to insist on the quantity survey being put into general operation, and the societies of the professions to insist that a bill of quantities be issued together with the plans and specifications.

EDW. H. BECK,
Chief Engineer,
The Lake Huron Steel Corporation, Ltd.
Goderich, Ont., October 2nd, 1919.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand or proposed, contracts awarded, changes in staffs, etc.

BRIDGES, ROADS AND STREETS

Assiniboia, Man.—Town council has made application to the Public Utilities Commission for a new subway under the C.N.R. and G.T.R. tracks.

Barrie, Ont.—Town council contemplates paving program for the main business streets, construction to commence next year.

Cumberland, B.C.—The department, of public works Victoria, contemplate repairs or construction of the road to Comox Lake, a direct road to Merville and the Royston-Qualicum road. Dr. J. H. King, minister.

Golden, B.C.—The building of a road from Golden to Leanchoil was urged upon Major A. W. Gray, chief engineer of highways, Dominion parks branch, at a meeting of the Golden Board of Trade, held recently.

Hamilton, Ont.—The suburban area commission have taken over the following roads: Road No. 1, Dundas and Waterloo, from the w. limits of Dundas to town line between Beverley and West Flamboro; road No. 7, Port Flamboro, from Toronto-Hamilton highway to water front; road No. 8, Waterdown Rd., continuing from the present terminus to Carlisle; road No. 11, Mt. Albion, continuing from the present terminus to Long's Corners; road No. 24, Barton St., continuing from the present terminus to intersection of road No. 23, known as the Burlington and Stoney Creek road; road No. 28, Garth St., from the Beckett drive to road allowance between concessions 5 and 6, thence w. to the sanatorium, and west to the Caledonia Rd. These roads will be maintained jointly by the city and county, each paying 30 per cent. of construction and 40 per cent. of maintenance, and the government, which pays 40 per cent. of construction and 20 per cent. of maintenance. T. J. Mahony, chairman.

Havelock, Ont.—The department of public works, Ontario, has authorized construction of road from Havelock to Trent river. Construction will probably commence this fall. W. A. McLean, deputy minister.

Hawkesbury, Ont.—Town council intends to construct a 5-ft. cement pavement along the south side of Regent St. Estimated cost, $2,600. Clerk, Eug. Paquette.

Kingston, Ont.—City council contemplates construction of pavement on Montreal St., to be laid in 1920.

Montreal, Que.—Contract has been awarded by the civic commission for rebuilding the Cote des Neiges Rd. to the Sicily Asphaltum Repairing Co. Contract price, $127,027.

Montreal, Que.—The contract for paving Notre Dame St. West, from Chaboillez Sq. to Dominion St., has been awarded by the Administrative Commission to the Sicily Asphaltum Paving Co., the lowest tenderer, for the sum of $41,756.

Peterborough, Ont.—Council contemplates construction of a temporary pile bridge, 22 ft. in width, to cross the river close to the Hunter St. bridge. The cost, which is estimated by C. J. Townsend, superintendent for the Russell-Townsend Co., bridge contractors, to be $4,970, will, it is understood, be borne by the contractors, and be included in the original contract for the Hunter St. bridge.

Pittsburgh Tp., Ont.—Tenders will be received by W. A. McLean, Deputy Minister of Highways, Parliament buildings, Toronto, until 12 o'clock noon on Tuesday, October 14th, 1919, for the construction of the concrete structures on the provincial highway in the township of Pittsburgh. Plans and specifications may be seen at the office of the City Engineer, Gananoque, Ont., and at the office of W. A. McLean.

Shellmouth, Man.—Tenders addressed to R. C. Desrochers, secretary, Department of Public Works, Ottawa, will be received until 12 o'clock noon, Tuesday, October 21st, 1919, for the renewing of floor of Shellmouth Bridge. Plans may be seen and specification obtained at the Department of Public Works, Ottawa; at the office of the District Engineer, Winnipeg, Man., and at the post-office, Shellmouth, Man.

Vancouver, B.C.—Contract has been awarded by the board of control for new guard pier at the Granville St. bridge to E. J. Ryan Contracting Co. Contract price, $12,283.30. Rejected tender, W. Greenlees, $13,356. Contract for class "B," which includes creosoting part of the superstructure, was also awarded to the E. J. Ryan Contracting Co. Contract price, $19,520.10. Rejected tender from Campbell and Shook, who tendered on class "A" work, which included creosoting all of the superstructure. Engineer, Mr. Fellowes.

Vancouver, B.C.—The ratepayers defeated the by-law to provide $110,000 for street and roadwork.

Winnipeg, Man.—Authorization for the construction of 277 miles of roads under the Good Roads Board was announced recently. The cost is $676,000. This brings the total mileage up to 3,758 miles at a cost of about $8,219,000.

Winnipeg, Man.—City council intends to construct a 24-ft. asphalt pavement on macadam base on River Ave., from Main St. to Osborne St. Estimated cost, $43,237. City clerk, C. J. Brown.

Winnipeg, Man.—City council intends to extend the boulevard on both sides of River Ave., from Main St. to Osborne St. Estimated cost, $3,000.

WATER, SEWAGE AND REFUSE

Assiniboia, Man.—Town council awarded contracts for sewer and water mains on several streets in St. James, and the necessary pipes, hydrants, valves and other materials, to T. Jackson and Sons, A. W. Green, T. E. Moen, The Canadian Foundries and C. C. Chown.

Chatham, Ont.—The Water Commissioners decided to have an 8-in. main laid from Park St. to the factory of the Dowsley Spring and Axle Co., along Foster St. and St. Patrick St. Four hydrants will be installed. Estimated cost, $5,559.

Deacon, Man.—W. G. Chace, chief engineer of the Greater Winnipeg Water District, has recommended the construction of a 250,000,000-gallon reservoir here as soon as possible.

Hamilton, Ont.—Dr. J. Roberts, medical health officer, city of Hamilton, will request council to purchase the chlorinating plant recently in use at the aviation field, Beamsville.

Montreal, Que.—The administrative commission have recommended to the city council the construction of a sewer on Cavendish Ave., from Cote St. Luc to Terrebonne Ave., at a cost of $28,000.

Penticton, B.C.—Next January the ratepayers will be asked to vote on a $35,000 by-law for a new reservoir and other extensions to the waterworks system. Clerk, B. C. Bracewell.

Peterborough, Ont.—The city engineer has recommended the following sewage disposal plant to council: the design of a two-story sedimentation plant, followed by sprinkling filters, these, in turn, to be followed by humus tanks, from

which the effluent would flow into the river. R. H. Parsons, city engineer.

Petrolea, Ont.—Tenders will be received until 6 p.m., October 15th, by the council of the township of Enniskillen for repair of the McCrae drain. A. Stonehouse and A. Elliott, commissioners.

Port Hope, Ont.—Tenders will be received by J. W. Sanders, town clerk, up to 12 o'clock noon on October 9th, 1919, for the construction of a sewer on Princess St., according to plans and specifications which are on file at the town clerk's office.

Quebec, Que.—The city medical health officer, Dr. Paquin, is advocating construction of a filtration plant to clarify and filter the domestic supply, obtained from Lake St. Charles.

Sarnia, Ont.—City council intends to construct a sewer on the east side of River St., from Chippewa to Clifford St.

Sarnia, Ont.—Tenders addressed to John A. Baird, city engineer, will be received up to noon, October 10th, 1919, for the construction of a vitrified sewer on Savoy St., from Devine to Confederation St. Plan and specifications may be seen at the office of the city engineer, city hall.

St. John, N.B.—Council has decided to construct water main and sewer on Jacques Cartier St. by day labor. Tenders rejected for sewer from Laurin and Leach; for water mains from Laurin and Leach, $11,343. Estimated cost from city engineer's tenders, sewer, $1,800; water mains, $10,000.

Wallaceburg, Ont.—Extensions to the town's waterworks plant and mains are being considered. Superintendent, Mr. McNeice.

LIGHT, HEAT AND POWER

Lakefield, Ont.—The ratepayers of Lakefield have endorsed the installation of the hydro-electric system throughout the town. Estimated cost of construction, $26,000.

TENDERS FOR ANNUAL SUPPLIES

Tenders will be received by registered post only, addressed to the Chairman, Board of Control, City Hall, Toronto, up to 12 o'clock, noon, Tuesday, October 28th, 1919, for the supply and delivery of:—

No. 1—Brass and Bronze Castings.
No. 2—Brass Work for House Services.
No. 3—Cast-Iron Pipe.
No. 4—Hydrants.
No. 5—Pipe, Fittings and Valves.
No. 6—Lead Pipe.
No. 7—Special Castings.
No. 8—Stop Valves.
No. 9—Refined Asphalt.
No. 10—Paving Blocks, Vitrified.
No. 11—Treated Wood Blocks.
No. 12—Sewer Brick.
No. 13—Iron Castings, Manholes, Gullies and Grates.
No. 14—Portland Cement.
No. 15—Mineral Dust.
No. 16—General Supplies.
No. 17—Gravel.
No. 18—Granite Setts.
No. 19—Iron and Steel.
No. 21—House Numbers.
No. 22—Oils.
No. 23—Sewer Pipe.
No. 26—Rubber Valves.
No. 27—Trap Rock.
No. 28—Sand.
No. 29—Crushed Stone.
No. 30—Rubble Stone.
No. 33—Trainmen's Uniform Suits.
No. 34—Liquid Chlorine.

Envelopes containing tenders must be plainly marked on the outside as to contents. Specifications and forms of tender may be obtained at the Works Department, Room 12, City Hall. Tenders must comply strictly with conditions of City By-law as to deposits and sureties, as set out in specifications and forms of tender. The lowest or any tender not necessarily accepted.

T. L. CHURCH (Mayor),
361 Chairman, Board of Control.

Minnedosa, Man.—The provincial power commission will undertake to provide the town of Minnedosa with a temporary power plant for the coming winter, and next year to provide a permanent plant, to have an ultimate capacity as follows: hydro-electric, 400 horse-power; steam auxiliary, 400 horse-power. R. M. Leamy, commissioner.

Ottawa, Ont.—Tenders will be received by the Ottawa Hydro-Electric Commission until 12 o'clock noon, October 10th, 1919, for one generator set. Specifications may be seen at the construction office of the Commission, 75 Laurier Ave. West. J. E. Brown, general manager.

Portage la Prairie, Man.—The Portage transmission lines, at present under construction, will be completed about December 1st. The construction of the power-house will be commenced immediately.

Wingham, Ont.—A by-law will be prepared, providing for taking of a plebiscite on the question of bringing hydro power into Wingham. The construction and installation of the proposed plant will cost $40,000.

Winnipeg, Man.—City council intends to install ornamental street lights on both sides of Donald St., from Portage Ave. to Graham Ave. Estimated cost, $3,200. City clerk, C. J. Brown.

Winnipeg, Man.—The provincial power commission have received applications for power from the following municipalities: Virden, Elkhorn, Oaklake and Oakville. R. M. Leamy, commissioner.

Yarmouth Tp., Ont.—Landowners, living between Orwell and St. Thomas and between St. Thomas and Sparta, have applied for approximaely 400 horse-power from the Hydro-Electric Power Commission. Provision was made in the construction of the St. Thomas power station to handle the additional lines necessary, and it is expected that construction of transmission lines will proceed immediately.

RAILWAYS

Calgary, Alta.—City council has agreed to two new street car line extensions. City clerk, J. M. Miller.

Edmonton, Alta.—The Utilities commission will recommend to city council the construction of extensions of the street railway along Brandon Ave., from the present terminus at Calder to a point not less than five blocks easterly. Construction to be completed this fall.

Edwardsburg Tp., Ont.—The C.P.R. is preparing plans for construction of branch line from the Ottawa-Prescott line, in Grenville county, to the section known as Crowder's Hill, in the township of Edwardsburg.

Halifax, N.S.—The C.N. Ry. will electrify the line between Halifax, N.S., and Moncton, N.B. The plans include construction of a large power-house at Maccan, Cumberland county.

Ottawa, Ont.—D. D. McKenzie will urge the Dominion government to extend the I.C. Ry. into the sections of the maritime provinces which are at present without railway communication.

Ottawa, Ont.—It is reported that the Canadian Pacific Ry. is projecting the construction of a spur line from its Ottawa-Prescott branch in Grenville county to the section known as Crowder's Hill, in the township of Edwardsburg. The spur line would be upwards of a mile in length.

Sherbrooke, Que.—Construction has commenced on the street railway extensions in the west ward of the city of Sherbrooke. J. Walsh, superintendent.

Vancouver, B.C.—Sir Donald Mann recently visited the Big Missouri mine near here, where he met in consultation Prof. Bancroft, of McGill University, and F. H. Minard, consulting engineer, of New York. A trail is being built connecting with the Premier mine-Stewart trail, and it is considered not improbable that a railroad may be built from the Big Missouri to Stewart next year.

Three views of Tarvia-filled macadam roads in County of York, Ont. Built with "Tarvia X" 1917, Toronto and York Roads Commission.

County of York (Ont.) Highways—Built and Maintained with Tarvia

THE highways shown in the three photographs are splendid examples of Tarvia roads.

All of these highways were constructed in 1917 with "Tarvia-X."

The photographs were taken more than a year later. Note the excellent condition of the roads—the smooth, firm, easy-traction surface.

Tarvia Ideal for the Roads of the Dominion

Using Tarvia for a binder makes a road waterproof and frost-proof, and for that reason Tarvia construction is particularly suited to the requirements of the roads of the Dominion which must be able to come through the severe Canadian winters without damage.

Experience has proved that Tarvia does away with the extensive spring repairs that untreated roads nearly always need after a hard winter.

Indeed, Tarvia proves to be a good investment of the taxpayer's money, not an expense, for in the long run Tarvia *pays for itself in lower maintenance cost.*

For instance, an occasional Tarvia treatment will keep these County of York highways mudless and dustless, and in fine condition indefinitely at very small cost.

We shall be glad to give you further information about these County of York roads on request. *Booklets free.*

Special Service Department

This company has a corps of trained engineers and chemists who have given years of study to modern road problems. The advice of these men may be had for the asking by any one interested.

If you will write to the nearest office regarding road problems and conditions in your vicinity, the matter will be given prompt attention.

Tarvia

Preserves Roads—Prevents Dust

MONTREAL TORONTO WINNIPEG VANCOUVER The Barrett Company LIMITED ST. JOHN, N.B. HALIFAX, N.S. SYDNEY, N.S.

Whitby, Ont.—One hundred delegates, representing municipalities along the old Toronto and Eastern Ry., have voted in favor of by-laws providing for acquisition and extensions of the Toronto and Eastern Ry. By-laws will probably be submitted in January.

Winnipeg, Man.—The Dominion government contemplates surveys for construction of a new line, approximately 75 mls. in length, extending into the mineral belt of northern Manitoba. Hon. T. C. Norris, Winnipeg..

FACTORIES AND LARGE BUILDINGS

Belleville, Ont.—Tenders will be received until October 17th by the department of public works, Ontario, for excavations for foundation and building concrete foundation walls of the new main building at the Ontario School for the Deaf. Plans, etc., at office of the bursar of the school and at the department. H. F. McNaughten, secretary.

Brandon, Man.—The Townsley Manufacturing Co. is building a new warehouse and factory on Ninth St.

Brantford, Ont.—A new $10,000 extension is being built to the Brantford Oven and Rack Co. works.

Brantford, Ont.—The board of education contemplate construction of an addition to the collegiate institute.

Brantford, Ont.—Contract for the erection of a new plant for the Robins and Myers Co. has been let to H. K. Forguseon, of Cleveland, Ohio. Only one large building is at present contemplated, 150 ft. by 360 ft.

Brantford, Ont.—The Dominion and the Ontario governments will pay 50 per cent. of cost of construction, and from 25 to 75 per cent. of salaries of instruction, in connection with the proposed new technical school for Brantford.

Calgary, Alta.—Contract has been awarded by the school board, for construction of school at Sunnyside to Fred. Jones Construction Co. Contract price, $34,493.

Chatham, Ont.—The Chamber of Commerce has passed a resolution in favor of the city council appointing a housing commission to construct homes under the provincial housing act.

Estevan, Sask.—The Dominion, Manitoba and Saskatchewan governments will establish, co-operatively, a lignite briquette manufacturing plant. Capacity of plant, 30,000 tons. J. M. Leamy, lignite board.

Galt, Ont.—The Royal Bank has purchased the old central hotel property, and will erect a new bank building next spring. W. Philip, manager.

Glace Bay, N.S.—A new schoolhouse may be built on York St. at a cost of $20,000.

Glace Bay, N.S.—The Dominion government has granted $85,000 for repairs to the harbor here.

Gladstone, Man.—School board decided to erect a new eight-roomed school building next spring at an estimated cost of $50,000.

Guelph, Ont.—Contract has been awarded by O. A. C. for construction of an apiary building to P. H. Secord & Son, Brantford. Contract price, $40,000.

Guelph, Ont.—The contract for the erection of an apiary building at the Ontario Agricultural College has been awarded to P. H. Secord and Son, of Brantford. The building will be of brick and stone, and will cost $40,000. P. H. Secord and Son have also secured the contract for the erection of an addition to the hardware foundry of the Taylor, Forbes Co. It will be 1,000 by 40 ft. and one story high, built of brick and steel, and will cost $15,500.

Ingersoll, Ont.—Directors of the Ingersoll Fair contemplate construction of a grandstand in the exhibition grounds.

Ingersoll, Ont.—Ratepayers will vote on October 17th, on the question of construction of a new Central school.

Kitchener, Ont.—A large theatre will be constructed on the north side of King St., between Foundry and Young St. Seating capacity, 1,700. Estimated cost, $150,000. Manager McCutcheon.

Lindsay, Ont.—Contract has been awarded by the Horn Bros. Woollen Mills, to John Gray Construction Co., Toronto, for construction of an addition to mill.

Lindsay, Ont.—It is expected that the school board will shortly have plans prepared for construction of additions to the collegiate institute.

London, Ont.—Plans are being prepared for construction of a new plant for London University to be erected on the Kingsmill farm. Work will probably commence in the spring. Estimated cost, $1,000,000.

London, Ont.—The Y.W.C.A. will erect a club-house and construct a swimming pool at Hunt's Flats, which has been presented to the association by the city of London.

London, Ont.—It is understood that a company is being formed to construct a ten-story hotel, containing 500 rooms, to be on the south-east corner of Dundas and Wellington St. Estimated cost, $1,000,000.

London, Ont.—Schemes for the expansion of Western University are maturing, and it is hoped that work on the construction of the new million dollar plant will be commenced within the next few months.

London, Ont.—A movement is on foot to create a million dollar endowment for a Roman Catholic college in this city which will include the removal here of L'Assomption College of Windsor and the Ursuline Academy of Chatham. Bishop Fallon has in hand about $500,000 for the extension of St. Peter's Seminary as part of the plan.

Midland, Ont.—The Curling Club will erect a new rink building this fall. Estimated cost, $14,000. Time of completion, January 1st, 1920.

Montreal, Que.—Repairs to Christ Church Cathedral, estimated to cost $40,000, are contemplated. Vicar, Rev. Dr. Symonds.

Montreal, Que.—A deputation, representing the legal profession of Montreal, recently waited on Sir Lomer Gouin, Premier of Quebec, to request his co-operation in constructing either a new wing to the present court house, or to construct an entirely separate building. Estimated approximate cost, $500,000.

Moose Jaw and Prince Albert, Sask.—Separate tenders will be received at the office of H. A. Dixon, chief engineer, Canadian National Railways, Winnipeg, until 12 o'clock noon, October 13th, 1919, for the supply of all labor and materials for the erection and completion of the following: Moose Jaw—Freight shed and offices. Prince Albert—Three-stall extension to engine-house. Plans and specifications may be obtained at the office of the district engineer, Saskatoon; building inspector, new C.N.R. station, Moose Jaw; agent's office, Prince Albert; architect's office, Winnipeg.

New Toronto, Ont.—Contract has been awarded by the Goodyear Tire & Rubber Co. for addition to factory as follows: McGregor & McIntyre, steel; Carmichael Waterproofing Co., Ltd., roofing. Estimated cost of building, $200,000.

Niagara Falls, Ont.—The collegiate board have awarded contract for technical school to the Canadian Engineering & Contracting Co., Hamilton. Contract price, $104,500. Rejected tenders from Dickie Construction Co., Hamilton, $112,000; John V. Gray Construction Co., Toronto, $133,800; R. O. Blayney, Niagara Falls, $117,700; W. Hodgins, Niagara Falls, $106,500. Additional costs for plumbing, heating and electrical work will probably increase total cost to approximately $125,000.

Niagara Falls, Ont.—The school board proposes to construct two additional rooms at the Glenview public school, $23,000; and four additional rooms at the Kitchener St. school, $40,000. W. J. Seymour, city clerk.

Oshawa, Ont.—Contract has been awarded by the board of education for construction of four-room addition on the rear of the Mary St. public school, to Davidson, Smith's Falls, $60,000. Contract for plumbing and heating not yet awarded.

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Oshawa, Ont.—The Russell-Navin Construction Co., Toronto, have commenced work on construction of examining warehouse on Wellington St. Cost of building, $23,000.

Ottawa, Ont.—The directors of the Hunt and Motor Club plan extensions to the club house, which includes provisions for a new banqueting hall. W. Y. Denison, 298 Laurier Ave., secretary.

Ottawa, Ont.—The hospital board recommends to board of control, the appointment of Stevens and Lee, Toronto, as architects for the design of the new hospital. Retaining fee to be 7 per cent. of total cost. Approximate cost of hospital, $1,500,000. D. M. Finnie, chairman of board.

Peterborough, Ont.—Contract for construction of the Memorial school, recently awarded to Graham and Hayes (see *The Canadian Engineer*, issue of September 25th, page 50), has been cancelled and awarded to R. Sheehy. Contract price, building, $160,000.

Preston, Ont.—Additional improvements for Speed Park, contemplated by the parks board, are as follows; to provide a bathing pool with pure filtered running water from the Speed River; to provide a pavilion for dancing, refreshments and general shelter; to erect a large grandstand; to improve the river bank and provide boat houses; and to construct permanent walks and driveways.

Regina, Sask.—Contract has been awarded to the Poole Construction Co., by the Canadian Consolidated Rubber Co., for construction of three additional stories in steel and reinforced concrete to the present warehouse at 1118 Broad St. Contract price, $40,000.

Regina, Sask.—The contract has been awarded for the erection of a warehouse for H. G. Smith to Thos. Barnard, of this city, at a figure in the neighbourhood of $40,000. Architects, Storey and Van Egmond. Work on the new structure will commence at once.

Regina, Sask.—The following permits have been issued by the building inspector's department; factory for the Sanitary Bakers, Ltd., $45,000; factory for the Allen bakery on Garnet St., $15,000; warehouse on Broad St., for the Goodyear Tire and Rubber Co., $68,000.

Russell, Man.—Tenders for the erection and completion of a metal-clad curling and skating rink will be received by A. B. Callin, town clerk, up to 8 o'clock p.m., Monday, October 13th. Plans and specifications may be seen at the clerk's office, or at the office of the Metal Shingle and Siding Co., Dublin Ave., Winnipeg.

Selkirk, Man.—Hon. George Grierson, Provincial Minister of Public Works, awarded the contract for the construction of a new laundry building for the Hospital for the Insane to the Carter, Halls, Aldinger Co., Winnipeg, for $47,229, and for the heating and plumbing apparatus and the installation of the machinery to the James Ballantyne Co., Ltd., of Winnipeg, for $18,275.

St. Boniface, Man.—A building permit has been granted to the Ceiling and Roofing Co. to build a 100 by 125 ft. addition to their plant for the manufacture of sheet metal products. Estimated cost, $15,000. The contractors are Carter, Halls, Aldinger Co., Winnipeg.

St. Boniface, Man.—The Western Wheel and Foundries Co., Winnipeg, a subsidiary of the Dominion Wheel and Foundries, Ltd., will establish large works here. The capacity of the plant will be 100,000 car wheels a year. The first unit will be completed so that operations may be commenced early in 1920. J. A. Kilpatrick is president and general manager.

St. Stephen, N.B.—Extensions will be constructed to the shoe factory, owned by the municipality, and operated by the Clark Bros. Shoe Co.

St. Thomas, Ont.—Board of education contemplates construction of a six-room school in the Wilson Ave. district. Estimated cost, $75,000. Tenders will soon be called. Architect, Darrach.

St. Thomas, Ont.—Molsons Bank have received permit for construction of bank building at the corner of Talbot and Flora St. Estimated cost, $37,000.

Thorold, Ont.—Tenders will be received until 5 p.m., October 15th, by the Great War Veterans' Association, for construction of club building. Plans, etc., A. B. Begg, Front St., Thorold, or architect, T. D. Mesler, 110 St. Paul St., St. Catharines, Ont.

Toronto, Ont.—The Merchants Bank will erect a four-story bank building at 12 King St., West. Estimated cost, $180,000.

Toronto, Ont.—Wm. Davies has intimated his intention of donating $30,000 for the erection of a women's residence in connection with McMaster University, University of Toronto.

Vancouver, B.C. — Ratepayers defeated proposals to spend $511,000 on erection of new schools, including a technical school building and equipment.

Vancouver, B.C.—The Standard Motors, Ltd., have taken out a permit for the erection of a new garage and showrooms at the corner of Eighth Ave. and Kingsway, to cost $22,000. The building will be of concrete.

Vancouver, B.C.—The Britannia Wire Rope Co., Ltd., with which is associated the local firm of Gibson's Ltd., has been registered with an authorized capital of $100,000. A site has been secured on Granville Island for the erection of a factory.

Windsor, Ont.—Plans are being prepared for construction of a large modern moving picture theatre on Wyandotte St. F. S. Ferguson, Standard Iron Foundry, Walkerville, director.

Windsor, Ont.—The C.P. Ry. will construct a large new freight shed, which will have modern freight handling equipment. A. Williams, superintendent.

Winnipeg, Man.—The Riverview Lawn Bowling Club plan to erect a curling rink building late this fall.

Winnipeg, Man.—A. J. Holling, steel manufacturer, Sheffield, England, while in Winnipeg recently, announced his intention of transplanting his works from Sheffield to Winnipeg.

Winnipeg, Man.—Weidman Brothers, 244 Jarvis Ave., have received a permit to alter their premises from a one-story to a three-story structure. A. J. Burnett and Sons have the contract, and M. Blankstein is the architect.

Winnipeg, Man.—Plans for the construction of the nurses' home in connection with the Winnipeg General Hospital are being revised by the engineer for the hospitals' commission. It is expected that construction will begin immediately. Estimated cost, $300,000.

Winnipeg, Man.—Building permits for September totalled $624,050 as against $144,850 for the corresponding month of last year. Official figures from the building inspector's department also show that to this date last year the aggregate was $1,892,750, as compared with $2,115,900 to date this year.

York Tp., Ont.—Tenders will be received until 12 o'clock noon, October 15th, by the York Tp. Housing Commission for construction of dwellings on the following streets; Eaton Ave., Johnstone Ave., Hillcrest Bvd., Westlake Ave., Dawlish Ave., Raymond Ave., and Meagher Ave. J. A. Martin, secretary, 40 Jarvis St., Toronto.

MISCELLANEOUS

Esquimalt, B.C.—The provincial government will call for tenders about the middle of this month for the construction of the Esquimalt drydock.

Glace Bay, N.S.—The department of public works, Ottawa, will improve the harbor as soon as the Dominion Coal Co. transfers ownership to the department. Channels will be dredged. Appropriation, $50,000.

(Concluded on page 54)

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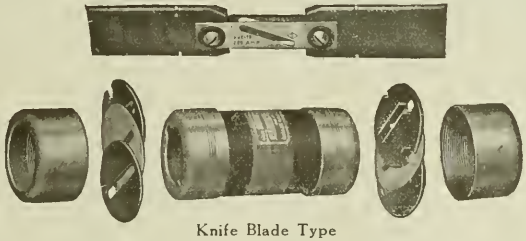

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FAIR WAGE SCHEDULES

Public notice is hereby given that, under the provisions of Section 10, Chapter 1, of the Statute of Manitoba, 1916 (being the Fair Wage Act, 1916), the Minister of Public Works has approved of the rates per hour and working hours set forth in the following schedule, with the minimum rate per hour payable to any employee engaged in the respective trades, and the maximum number of hours during which any employee engaged in the respective trades shall be required to work; and that the said schedule shall apply and be effective for employees engaged on public works on or at the building; and that the said schedule shall be effective from the first day of September, A.D. 1919, to the thirtieth day of April, 1920, or until such time as another order may be made by the said Minister of Public Works.

Fair Wage Schedule for Winnipeg

The following schedule shall apply to the City of Winnipeg and a radius of thirty miles therefrom, from the first day of September, 1919, to the thirtieth day of April, 1920:—

	Rate per Hour.	Hours per Week.
1. Common Laborers	.45	54
2. Builders' Laborers (being those directly engaged assisting tradesmen, not otherwise classified)	.55	50
3. Teamsters (employed directly from or on the buildings)	.50	60
4. Bricklayers	$1.00	44
5. Stonemasons	$1.00	44
6. Marble Setters	.95	44
7. Mosaic and Tile Setters	.77½	44
8. Terrazo Workers—		
(a) Layers	.70	44
(b) Helpers	.55	54
9. Stone Cutters—		
(a) Carvers	.97½	44
(b) Journeymen	.85	44
(c) Planermen and Lathemen	.75	44
10. Plasterers	.90	44
11. Wood, Wire and Metal Lathers	.75	44
(a) Where Metal Lath only is used	.80	44
12. Plumbers	.80	44
13. Steamfitters	.80	44
14. Operating Engineers on Construction—		
(a) Engineers in charge of machines of three or more drums	$1.00	50
(b) Engineers in charge of double-drum machines	.90	50
(c) Engineers in charge of single-drum machines	.80	50
(d) Firemen	.55	50
15. Sheet Metal Workers	.73½	44
16. Painters, Decorators, Paperhangers and Glaziers	.70	44
17. Blacksmiths	.70	44
18. Electrical Workers (Journeymen Inside Wiremen)	.75	44
19. Bridge and Structural Steel and Ironworkers	$1.00	44
20. Asbestos Workers—		
(a) Journeymen	.80	44
(b) First Class Improvers	.70	44
(c) Second Class Improvers	.60	44
21. Asphalters—		
(a) Finishers	.60	44
(b) Men engaged preparing, mixing and heating materials	.45	54
22. Carpenters	.75	44

Fair Wage Schedule—Province of Manitoba (Exclusive of Winnipeg)

	Rate per Hour.	Hours per Week.
1. Common Laborers	.40	54
2. Builders' Laborers (being those directly engaged assisting tradesmen, not otherwise specified)	.50	50
3. Teamsters (employed directly from and on the building)	.45	60
4. Bricklayers	$1.00	44
5. Stonemasons	$1.00	44
6. Marble Setters	.95	44
7. Mosaic and Tile Setters	.77½	44
8. Terrazo Workers—		
(a) Layers	.70	44
(b) Helpers	.55	54
9. Stone Cutters—		
(a) Carvers	.97½	44
(b) Journeymen	.85	44
(c) Planermen and Lathemen	.75	44
10. Plasterers	.90	44
11. Wood, Wire and Metal Lathers	.75	44
(a) Where Metal Lath only is used	.80	44
12. Plumbers	.80	44
13. Steamfitters	.80	44
14. Operating Engineers on Constructions—		
(a) Engineers in charge of machines with three or more drums	$1.00	50
(b) Engineers in charge of double-drum machines	.90	50
(c) Engineers in charge of single-drum machines	.80	50
(d) Firemen	.55	50
15. Sheet Metal Workers	.73½	44
16. Painters, Decorators, Paperhangers and Glaziers	.70	44
17. Blacksmiths	.70	44
18. Electrical Workers (Journeymen Inside Wiremen)	.75	44
19. Bridge and Structural Steel and Ironworkers	$1.00	44
20. Asbestos Workers—		
(a) Journeymen	.80	44
(b) First Class Improvers	.70	44
(c) Second Class Improvers	.60	44
21. Asphalters—		
(a) Finishers	.60	44
(b) Men engaged preparing, mixing and heating materials	.45	54
22. Carpenters	.75	44

Fair Wage Schedule—New Parliament Buildings, Winnipeg

The following schedule shall apply and be retroactive on the work of the new Parliament Buildings, Winnipeg, from July 1st, 1919, to August 31st, 1919:—

Item No. 1—Common Laborers ..... .40c. per hour.
" " 2—Builders' Laborers ..... .50c. " "
" " 4—Bricklayers ..... .95c. " "
" " 5—Stonemasons ..... .95c. " "
" " 6—Marble Setters ..... .90c. " "
" " 7—Mosaic and Tile Setters ..... .75c. " "
" " 10—Plasterers ..... .85c. " "
" " 12—Plumbers ..... .75c. " "
" " 13—Steamfitters ..... .75c. " "
" " 18—Electrical Workers ..... .70c. " "
" " 22—Carpenters ..... .75c. " "

The following schedule shall be effective as retroactive from the first day of August, 1919, to the thirty-first day of the same month:—

Item No. 9—Stone Cutters—
(a) Carvers ..... .97½c. per hour.
(b) Journeymen ..... .85c. " "
(c) Planermen and Lathemen .75c. " "

By Order. (Sgd.) GEORGE A. GRIERSON,
Minister of Public Works.

Dated at the Office of the Provincial Secretary this twenty-fifth day of September, A.D. 1919.

360 (Sgd.) J. W. ARMSTRONG, Provincial Secretary.

Good Books for Municipal Engineers

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More space than heretofore is devoted to the calculating of the sizes of sewers, especially storm sewers, and to pumping sewage. Part II, treating Construction, and Part III, on Maintenance, on the other hand, have been condensed to one chapter each. The book as a whole covers thoroughly the fundamental principles and approved practices of both sewerage and sewage treatment.

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C.E.—10-9-19

MISCELLANEOUS

(Continued from page 50)

London, Ont.—By-law being prepared by city council to be voted on in January provides $100,000 for construction next summer of one-half of a partitioned reservoir on Springbank Hill. Total capacity of reservoir, 20,000,000 gals. Total cost of construction, $200,000.

Montreal, Que.—The Dominion Bridge Co., Ltd., has been awarded contract by the Laurentide Paper Co. for construction of an entire set of paper-making machines. Work will be undertaken at the Lachine plants.

Port Colborne, Ont.—The Athletic Club will construct an artificial ice plant in connection with the new rink building.

Port Maitland, Ont.—Tenders will be received until 12 o'clock noon, October 20th, by the department of railways and canals, Ottawa, for reconstruction of the east pier at Port Maitland, Ont. Plans, etc., at office of superintending engineer, St. Catharines, Ont., and at the department. J. W. Pugsley, secretary.

Prescott, Ont.—It is said that the G.T. Ry. will erect a large coal storage terminal at Prescott.

St. Catharines, Ont.—The department of railways and canals, Ottawa, have issued orders to stop work and dismantle plant on section No. 2, Welland ship canal. Contractors, Baldry, Yerburgh & Hutchinson.

Ste. Famille, Que.—Tenders will be received until 12 o'clock noon, October 16th, for repairs and reconstruction to wharf. Plans, etc., offices of district engineers, post office building, Quebec, Que.; Shaughnessy building, Montreal, Que.; and at post office, Ste. Famille, Island of Orleans, Que. R. C. Desrochers, secretary.

Vancouver, B.C.—The board of trade have requested the Dominion government to proceed with the work of the harbor improvements, for which $5,000,000 has been voted. H. H. Stevens, M.P.

Winnipeg, Man.—Judgment given by Justice Curran orders T. H. Kelly, contractor, to repay to the government of Manitoba $1,207,351.65, with interest at 5 per cent. since July 1st, 1914. The board of appraisal decided that this amount had been overpaid during construction of the Manitoba parliament buildings.

Tenders Called For

UNITY, SASK.

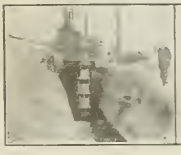
Sealed Tenders registered and endorsed on the envelope, Tenders for (tender bid on) and addressed to J. M. Jensen, Secretary-Treasurer of the Town of Unity, Sask., will be received up to 6 p.m., October 15th, 1919, for the supply, delivery and erection of the following machinery and materials and for the performance of certain works:—

Tender A. For the supply, delivery and erection of one internal combustion engine.
Tender B. For the supply, delivery and erection of one generator excitor, switch-board, transformers, meters, etc.
Tender C. For the supply and delivery of one oil storage chamber.
Tender D. For the supply and delivery of pole, wire and line material.
Tender E. For the erection of electric pole line.
Tender F. For the erection of Power station and cooling tank.

Marked cheque for five per cent. (5%) of the amount of the bid must accompany each tender.

Complete sets of plans and specifications may be seen at the office of the Consulting Engineers, Saskatoon, at the Secretary-Treasurer's office, Unity, Sask. Specifications on tenders A., B., C. and D. may be seen at the office of *The Canadian Engineer*, Winnipeg and Toronto, and the Contract Record office, Montreal.

J. M. JENSEN, Esq.,
Secretary-Treasurer,
Unity, Sask.
MURPHY & UNDERWOOD,
Consulting Engineers,
Saskatoon, Sask.
352



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ENGINEER WANTED to take charge of a Buffalo office of a Canadian engineering and contracting firm doing contract work. Duties are partly engineering and partly selling. Good opportunity for live man. Address Box 13, *Canadian Engineer*, Toronto.

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ENGINEER WANTED to take charge of Engineering Department for large pulp and paper company who are making large extension to their development. He must have a good education and years of experience in similar position. He must have good executive ability, experience in making out specifications and contracts and in buying. Salary, $10,000 a year. With applications pleace give information in detail as to education, experience, age, married or single, and copy of references. Address Box 15, *Canadian Engineer*, Toronto.

COMMISSARY work for construction undertakings is my specialty. Before entering this line, I had eight years' experience as an accountant in the Canadian Bank of Commerce in Toronto and other Canadian cities. Am a Canadian, married, good references. During last year of war had entire charge of all feeding and living accommodations, timekeeping, etc., for large shipbuilding corporation in United States. Interview solicited. Address Box 398, *Canadian Engineer*, Toronto.

The Canadian Engineer

A Weekly Paper for Civil Engineers and Contractors

Heavy Steel Highway Bridging at the Front

Four General Types Used by the British Army in France for Spans Greater Than 30 Ft.—Inglis, 60-Ft., 85-Ft. and Hopkins Types—Loads, Foundations, Details of Design and Novel Methods of Launching

By A. C. OXLEY, M.C., D.C.M.

Formerly Lieutenant, 10th Canadian Engineer Battalion

IN the following brief record of the methods and types of spans used for highway bridges by the British Army during the recent great war, no attempt is made either to discuss standard-gauge railway spans or to take up in detail the very first bridges erected after an advance—namely, the infantry barrel-pier footbridges and the pontoon bridges used by the first-line transport.

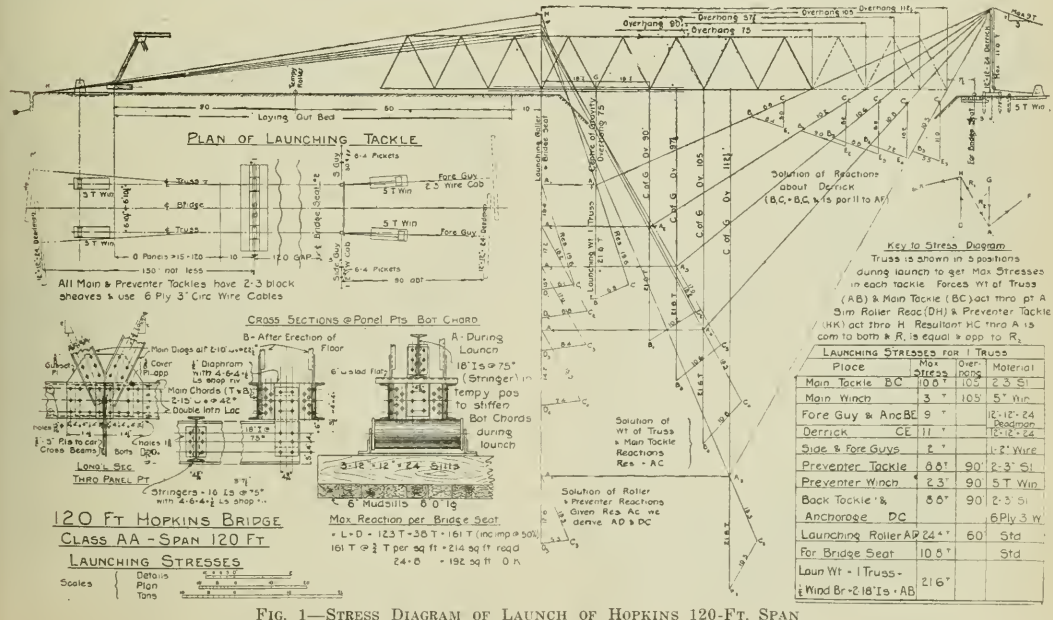
The subject to be discussed may be called "Heavy Highway Bridging" for loads starting with the standard three-ton-capacity lorry and reaching their limit in the modern tank. The loads and methods are those of the British "G.H.Q. Heavy Bridging School," which, during the course of the war, in the winter months only, gave a series of courses of from two to three weeks' duration, to officers and others of the Royal Engineers and colonial engineering units who had already received all the usual technical training in light bridging and who had also received a fair share of "battle training."

The bridging school, under Lt.-Col. Robinson, with its supply base at Havre, was organized on the assumption that the Germans would fight a strong rearguard action from the Ypres-Amiens line clear back to the Rhine, destroying all bridges and communications on the way. Records and plans were obtained and kept of all bridges constructed before the war in Belgium and North-east France, and enough material was stocked at Havre to replace the bridges most essential for the re-establishment of communications. Actually, the destructiveness of the Germans ceased near Mons and the destroyed gap was only about 60 miles in width.

Loads

Following is the classification of bridges by loads from the AA class, which carried tanks, to the H class, which carried infantry in single file:—

Class AA—Crowded 30-ton tanks.
" A—17-ton axle loads at 15-ft. centres, or whippet tanks.
" B—Caterpillars at 11 tons.
" C—Foden 5-ton-capacity steam lorries.
" D—3-ton lorries, 60-pdr. guns.


PLAN OF LAUNCHING TACKLE
All Main & Preventer Tackles have 2-3 block sheaves & use 6 Ply 3" Circ Wire Cables
CROSS SECTIONS @ Panel Pts BOT CHORD
120 FT HOPKINS BRIDGE
CLASS AA - SPAN 120 FT
LAUNCHING STRESSES
Max Reaction per Bridge Seat
Solution of Reactions about Derrick
Solution of Roller & Preventer Reactions
Key to Stress Diagram

LAUNCHING STRESSES FOR 1 TRUSS			
Place	Max Stress	Overhang	Material
Main Tackle BC	106 T	105'	2-3" SI
Main Winch	3 T	105'	5" Win
Fore Guy & Anc BE	9 T		2-12"-24 Deadman
Derrick CE	11 T		10-12"-24
Side & Fore Guys	2 T		1-2" Wire
Preventer Tackle	66 T	90'	2-3" SI
Preventer Winch	2.3 T	90	5 T Win
Back Tackle & Anchorage DC	88 T	90	2-3 SI 6 Ply 3 W
Launching Roller AP	24 T	60	Std
For Bridge Seat	105 T		Std
Laun Wt + 1 Truss + ½ Wind Br + 2 18" Is + AB	216 T		

FIG. 1—STRESS DIAGRAM OF LAUNCH OF HOPKINS 120-FT. SPAN

Class E—Field guns (3-in. and 4.5-in. howitzers), and all horse-drawn vehicles.
" F—Infantry in file, pack mules.
" G—Cavalry, dismounted, single file.
" H—Single file infantry.

[NOTE.—Ordinary pontoons were of Class E only. All guns would go on Class B, except a 6-in. British long (naval). The Inglis bridge was rarely used for over a Class C. load.]

Tanks, of course, were in a class by themselves, but a "heavy" bridge was usually of at least B class and thus could carry all other highway traffic loads such as steam rollers and dismantled heavy howitzers, the tractors of which imposed an axle load up to about 13 tons.

The tank was regarded as having its load of 30 tons distributed over a length of 4 ft. and its "sponsons" for its 6-pounders, or machine guns, projected to a total width of 12 ft. 9 ins., which was much in excess of the standard clearance width of 11 ft. 6 ins. It was, therefore, frequently necessary for a tank to draw in its sponsons in order to cross a bridge, and so be delayed for several hours. The standard height clearance was 12 ft. 6 ins., which was close enough to compel passengers to descend from the second story of the London busses so often seen at the front.

Foundations

All spans were of steel, with close fitting bolt connections. These bolts were 1¼ ins. or $1\frac{5}{16}$-in. diameter of shaft, with a threaded end of 1⅛ ins. or $1\frac{3}{16}$ ins. respectively, which both ensured tightness and also minimized danger of stripping bolt threads.

The foundations normally were simply timber mudsills and one to three 12 by 12-in. timber bridge seats for abutments on dry firm soil. For piers it was often necessary to construct pile trestles. The loading on mudsills was kept down to about ¾ ton per sq. ft., and care was taken to keep the toe of the mudsill at crest within a 1 to 1 slope to water level.

The bridge rollers on the larger spans were about 3 by 4 ft. on their base, giving a good bearing area on bridge seats, and the latter were figured as beams with trusses causing two downward concentrated loads, and mudsills causing a distributed upward reaction. Each 12 by 12-in. bridge seat was continuous under both trusses in order to avoid unequal settlement.

In certain cases such as when a canal with a tow path was being bridged, cribs were built of steel cubes, with 4-ft. face, of light angles. These cribs were not allowed to exceed 12 ft. in height and could not be used to advantage in midstream.

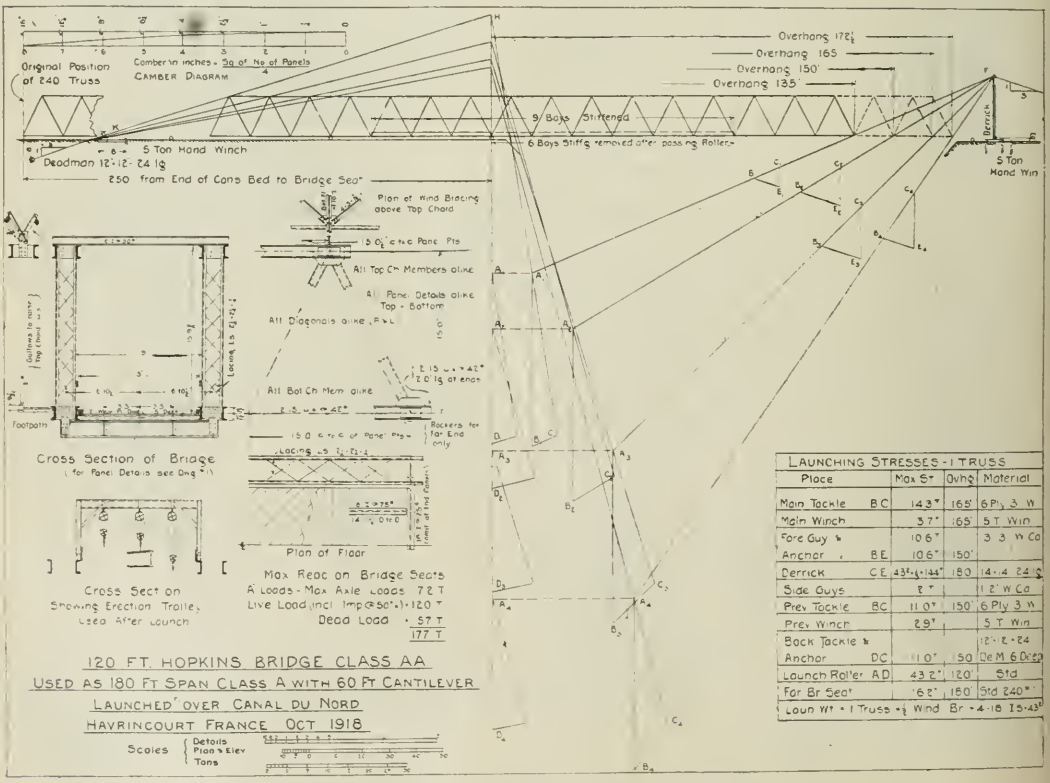
Piling was often done with man or horse power lifting a 1,500-lb. monkey on the formula:—

Bearing strength of pile = [(Fall of M, in ft.)$^{1/3}$ × (Wt. of M, in cwt.) × ½] ÷ [1 + (set of last blow, in ins.)]

It was found that working outwards from the shore was very slow, and it was often possible to use the bridging pontoons as rafts and to drive from them. For a pile-bent trestle it was then possible to construct the whole bridge of pontoons and to drive a bent between each pair of close-lashed pontoons.

Four Types of Bridges

Four general types of bridges were used for spans of over 30 ft. (Below this size merely enough rolled steel


Original Position of 240 Truss
CAMBER DIAGRAM
Overhang 172½
Overhang 165
Overhang 150'
Overhang 135
9 Bays Stiffened
6 Bays Stiffs removed after passing Rollers
Derrick
5 Ton Hand Win
5 Ton Hand Winch
Deadman 12'-12'-24 lg
250 from End of Cons Bed to Bridge Seat
Plan of Wind Bracing above Top Chord
All Top Ch Members alike
All Panel Details alike Top + Bottom
All Diagonals alike
All Bot Ch Mem alike
Rockers for far End only
Footpath
Cross Section of Bridge
Cross Section Showing Erection Trolley Used After Launch
Plan of Floor
Max Reac on Bridge Seats
A Loads - Max Axle Loads 72 T
Live Load (incl Imp @ 30%) + 120 T
Dead Load + 57 T
177 T
120 FT. HOPKINS BRIDGE CLASS AA
USED AS 180 FT SPAN CLASS A WITH 60 FT CANTILEVER
LAUNCHED OVER CANAL DU NORD
HAVRINCOURT FRANCE OCT 1918
Scales Details Plan & Elev Tons

LAUNCHING STRESSES - 1 TRUSS

Place		Max St	Ovhg	Material
Main Tackle	BC	143 T	165'	6 Ply 3 W
Main Winch		37 T	165	5 T Win
Fore Guy &		106 T		3 3 W Co
Anchor "	BE	106 T	150'	
Derrick	CE	433 + 144 T	180	14-14 24 lg
Side Guys		8 T		11 2 W Co
Prev Tackle	BC	110 T	150'	6 Ply 3 W
Prev Winch		29 T		5 T Win
Back Tackle &				12-12-24
Anchor	DC	110 T	150	De M 6 Deep
Launch Roller	AD	43 2 T	120'	Std
For Br Seat		162 T	180	Std 240 T

Loun Wt + 1 Truss + Wind Br = 4-18 15-43

FIG. 2—STRESS DIAGRAM OF LAUNCH OF HOPKINS 180-FT. SPAN

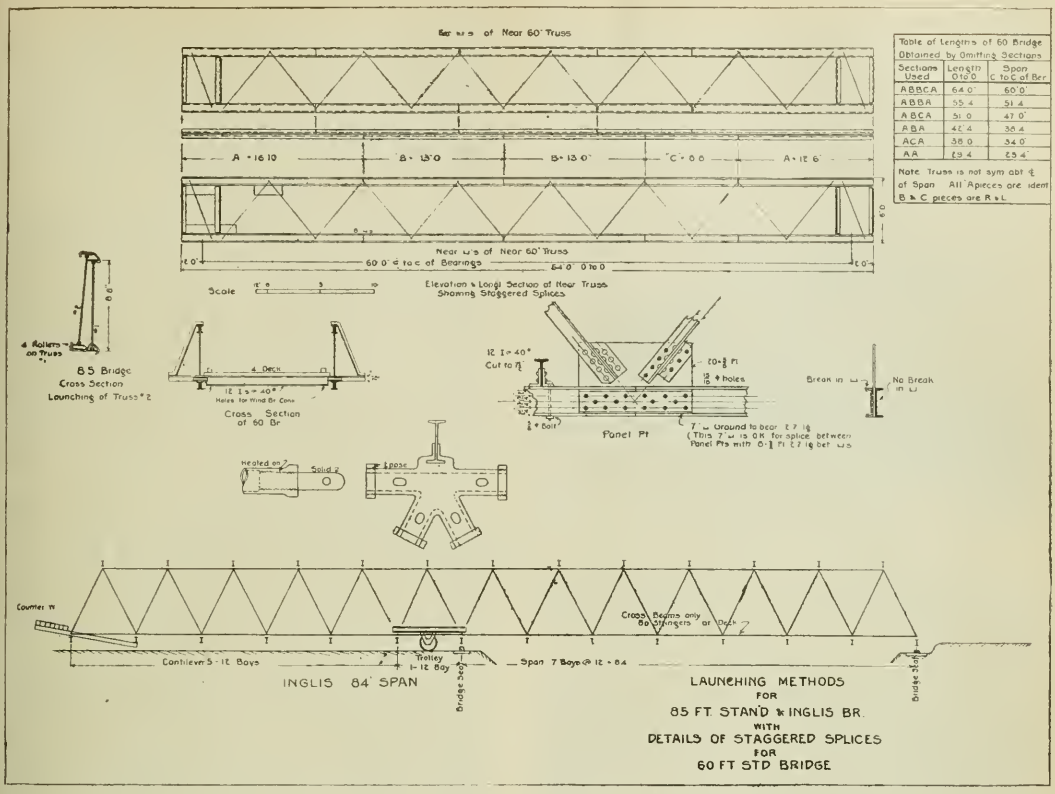


Table of Lengths of 60 Bridge Obtained by Omitting Sections
Sections Used
Length O to O
Span C to C of Ber
ABBCA 64.0" 60.0"
ABBA 55.4 51.4
ABCA 51.0 47.0"
ABA 47.4 36.4
ACA 38.0 34.0"
AA 29.4 25.4"
Note. Truss is not sym abt ℄ of Span All Apieces are ident B & C pieces are R & L
A = 16.10
B = 13.0
B = 13.0
C = 0.0
A = 12.6
Near c/s of Near 60' Truss
60.0" c to c of Bearings
64.0 O to O
Elevation & Longl Section of Near Truss Showing Staggered Splices
Scale
4 Rollers on Truss
85 Bridge Cross Section Launching of Truss
4 Deck
Cross Section of 60 Br
Holes for Wind Br Conn
Panel Pt
Break in
No Break in
Heated on
Solid
Spade
Counter
Cantilever 5 - 12 Bays
Trolley 1 - 12 Bay
Span 7 Bays @ 12 = 84
Cross Beams only 60 Stringers or Deck
INGLIS 84' SPAN
LAUNCHING METHODS FOR 85 FT. STAND & INGLIS BR. WITH DETAILS OF STAGGERED SPLICES FOR 60 FT STD BRIDGE

FIG. 3—ERECTION AND LAUNCHING DETAILS OF 60-FT., 85-FT. AND INGLIS BRIDGES

joists—or R.S.J.'s were used to make up the necessary span and strength.) Of these four general types, two—the Hopkins and Inglis—are through bridges, and the other two are known as the 60-ft. and 85-ft. spans. The two latter were half deck if used in one position, or deck type if inverted. All these bridges could be varied in length, below the maximum for which they were designed, simply by omitting sections. No field riveting was done, close fitting 1¼-in. diameter black bolts being normally used, and large pins in the Inglis.

Inglis Bridge

The Inglis was originally designed with a triangular cross-section and only a single top chord, but that proved inefficient, and the later Inglis type was rectangular in cross-section. In the Inglis bridge (See Drawing No. 3), the cross-beams, both ledgers and transoms, were R.S.J. sections, with four sockets in the vertical plane at each of their ends. These sockets were pierced by heavy cross pins. The members of the trusses were heavy steel 5-in. pipes, with solid projecting ends pierced by cross holes. These truss members were slipped into the sockets on the transoms and ledgers, and the cross pins inserted. The holes, however, were slotted, so there was way to take up, and a screw sleeve on the bars was turned to prevent movement.

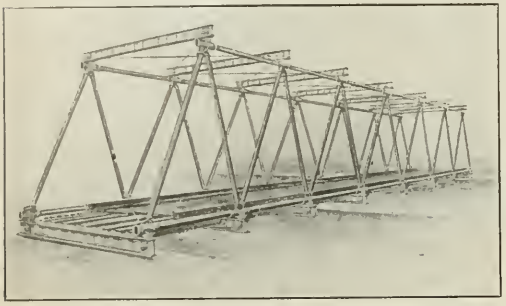
The Inglis bridge was designed in identical 12-ft. panels and made a series of equilateral triangles of the Warren type. Its great advantages were (1) speed of its erection, and (2) portability. It was often used for a week or two until a heavier bridge was erected alongside, when it was dismantled and shipped by lorry further forward.

The well-known picture, "Canadians Bridging Canal du Nord, Arras-Cambrai Road, September 28th, 1918," shows an Inglis bridge in use on the centre line of the highway. Later, two Hopkins bridges were erected on a diversion site close alongside. This Inglis bridge was good only for a Class C load of 8 tons per axle at a span of 120 ft., but it was good for a Class A load of 17 tons per axle at 72 ft. The span was about 108 ft., but the original civilian girder bridge had been dropped bodily into the shallow water directly beneath, and on the visible few inches of its top chord, a crib had been erected to support the Inglis bridge, and therefore, with a maximum span of, say, 60 ft., it could have been used for any British gun, but not for tanks.

The history of its erection is briefly this: The canal was crossed at 5 a.m., September 27th, on a dry portion about three miles south of the highway. The attacking Canadians then passed north and consolidated on the far side at approximately 8 a.m. Barrel-pier and pontoon bridges were rapidly thrown over, and by noon our field artillery were fully two miles in advance of the canal. The erection of the Inglis was commenced about noon. In addition to its true nine spans, this length required a counterweight of six more spans, in addition to a "trolley" span (in the centre) which acted as a carriage for the progression of the whole in launching. The 16 spans were not completed until dark, and as it was unwise to use lights owing to hostile aircraft, the launching was postponed until dawn. The bridge was in commission about 11 a.m., September 28th, and was used for several weeks.

The method of launching the Inglis was slightly different from that of launching the other types. All spans over 30 ft. were built on shore and launched without falsework in the river, but this type had a two-wheeled trolley, secured by jacks, just back of its rear "bridge seat." Back

of this again were about two-thirds as many panels as in the span itself. The last panel was counterweighted with some of the decking and a small live load of men, the forward end of the bridge being in skeleton only. The trolley was then manhandled slowly forward, with the forward bridge seat slightly raised, and on reaching its final position the structure was lowered. The trolley and counterweight spans were rapidly dismantled, and the stringers, solid planking and hand-railing put in place. The total labor allowance for a 120-ft. span was about 2,000 man-hours.



Typical Inglis Bridge

The other long span types were also erected without falsework and usually without a counterbalancing arm, and as the system of tackle was identical in principle in all spans over 30 ft. to a maximum of 180 ft., it will later be discussed in detail.

The 60-Ft. Span

The 60-ft. type was originally of Class A strength, but by using $1\frac{5}{16}$-in. diameter black bolts at the panel points in place of $1\frac{3}{16}$-in. diameter bolts, it was subsequently in Class AA category and could carry single tanks. Its girders were Warren trusses, the complete span being shipped in five pieces per truss—namely, 2A, 2B and 1C (see Drawing No. 3), all joints being staggered, only a single 7-in. channel and 8 by $\frac{5}{8}$-in. plate being needed at each splice. Each main member was composed of two 8-in. channels.

By the omission at will of any of the B or C pieces, the overall length of 64 ft. could be reduced to 55 ft. 4 ins., 51 ft. 0 ins., 42 ft. 4 ins., 38 ft. 0 ins. or 29 ft. 4 ins. as required.

The cross-beams, consisting of 12-in. I's at 40 lbs., were spaced in pairs between (but close to) the panel points, and had their depth at ends reduced to 7½ ins. to avoid fouling diagonals. They were bolted by their angles through the vertical centre line of trusses, and wind-bracing flats were bolted to their lower flanges. Five of them extended far enough beyond trusses to allow lateral vertical braces against upsetting of trusses.

The 4-in. decking was laid longitudinally and flared out for 4 ft. at 30 degs. at end of trusses, in the usual way, to join a graded earth roadway.

The 85-Ft. Span

The 85-ft. standard span was of similar type, but had a total depth of 8 ft. 6 ins. The main chords were of two 5 by 4 by ¾-in. angles, stiffened with a vertical web plate. This type was often used near Etaples in crossing the tidal river. Two spans were usually sufficient. Two bridges were used for highway traffic, but a third one was erected for the eventual use of the narrow gauge (60-cm. or 24-in. gauge), upon which the B.E.F. would have had to rely had they lost St. Pol in the great "Battle of France," which started March 21st, 1918. Actually, rails were not laid nor the approaches graded.

The chords of this type had greater lateral stiffness than those of the 60-ft. type, and it was quite common to launch them singly in cantilever; that is, the two trusses were erected on shore and bolted end to end. Truss 1 was then pushed and rolled until its far end reached a pier in mid-stream. The erection bolts were then removed and four special cradle rollers attached to the lower flange of Truss 1. Truss 2 was then slid along this "track." This method was particularly useful in multi-span bridges, as the tackle system of launching was only at its best in one-span bridges, where the height of its mast was of most use.

Hopkins Bridge

The Hopkins 120-ft. span was the largest, longest and had the highest load-bearing capacity of any of these G.H.Q. highway bridges. The method of its erection is shown by Drawings Nos. 1 and 2.

The erection on shore was carried out with no equipment beyond the necessary wrenches and 2-in. hemp rope, with suitable block and tackle. After laying out with camber, as shown, the party was divided into four, one for each end of each truss. All diagonals were hoisted by inserting first only one bolt per gusset plate and swinging in a vertical plane. The angles used as gallows with which to hoist the 15-in. channels of the top chord were later used as hand-rail posts. Used as originally designed they gave insufficient clearance for hoisting and were actually used with an extra plate to give height, the plates being those later used for fastening the floor cross-beams to the diaphragms.

The largest span of this type ever erected in the field was at Havrincourt, after the Canal-du-Nord operations of September 27th to October 10th, 1918. The clear span was 180 ft. and to avoid excessive strains and also excessive length of tackle, the span was partly counterbalanced by erecting 60 ft. of false or cantilever panels. The bridge then was still in equilibrium, without tackle, when overhanging about 120 ft., with the help of some decking as counterweight.

It will be observed that when the bridge was being rolled forward all stresses were reversed and the upward thrust of the rollers tended to distort the 15-in. channels of the lower chord. This was taken up by using an 18-in. 75-lb. R.S.J. floor stringer as a stiffener. In the normal case of a 120-ft. span on eight panels, only the two centre panels were thus stiffened, but in this extreme (Havrincourt) case, panels 4 to 12 were all stiffened, and the beams removed after crossing the roller to avoid overloading of the overhang.

Bridges of this type were launched in skeleton. The trusses were complete, and also the wind-bracing in the upper horizontal plane, but in place of the floor cross-beams and stringers, we had only a few pieces of decking wedged in place, with the diagonal tension taken up by means of wire ropes and turn-buckles. In the Havrincourt bridge, tarpaulins were slung below the flooring gang to save men and tools.

The bridge was launched from and supported by special rollers with a diameter of 12 ins. and a length of about 3 ft. 6 ins., as the two 15-in. channels of the lower chord were separated, and double latticed internally with 2½ by 2 by ¼-in. angles. Later a rocker was bolted under one end.

A footpath about 3 ft. wide was built on the outside of each truss, the angle-irons of its floor being spaced at 3 ft. centres, and only each alternate floor angle had an upright angle as support for the 1¼-in. diameter gas-pipe hand-rail. (See Drawing No. 2.)

A railing was also fastened inside of trusses (to guide road traffic) at an elevation of about 3 ft. The 5-in. decking was laid crosswise on the lower flange of 15-in. channels, and on two 18-in. 75-lb. I-beams spaced 6 ft. 6 ins. apart. These R.S.J.'s were set with tops of stringers about 2 ins. above tops of cross-beams, thus allowing small beveled plates to be riveted on the uncut lower flanges of the stringers and simplifying erection.

The floor was erected by means of a light steel trolley which ran on upper flanges of inner 15-in. channels. To facilitate erection the stringers were made only 14 ft. $11\frac{1}{16}$ ins. out to out on a panel length of 15 ft., and two ¼-in. fillers were later inserted. The cross-beams at side were

supported by both a long and a shorter plate, putting four of six bolts in bearing on web of 18-in. I and two in single shear. (See Drawing No. 1.)

The only other long span types of bridge were the 120-ft. Hopkins with an 18-ft. roadway, and a 75-ft. Hopkins. In the former, all chord and diagonal material was identical with the standard 120-ft. type, but the overhead horizontal wind-bracing was revised to suit, and two long plates at each end were used to fasten the 3-ft. cross girders. The 18-in. I's for stringers were practically unchanged in design but were increased to five in number.

The other type, the 75-ft. Hopkins, at the time of the armistice had never been erected. Its floor was to be identical with the 120-ft., but its top and bottom chords were to be only two 9-in. 19½-lb. channels, and its diagonals the same. It was designed to carry Class AA loads or tanks at 75 ft., single tanks at 105 ft., and all Class A loads of 17 tons at 120 ft.

The 60-ft. type was launched with tackle similar to that used for the 120-ft. type, but there was only one set to each bridge instead of one to each truss. The single derrick was braced sideways and allowed to lean slightly towards the bridge. Care had to be taken in every case when launching to adjust all tackle correctly, as it was only by fastening the tackle to the bottom of the forward end and the top of the rear end that the rotating couple of the downward thrust of the bridge and the upward thrust of the roller were counterbalanced by an equal and opposite couple.

The normal time for launching alone was about 40 minutes, and the labor cost of the entire erection of a 120-ft. Hopkins was 4,000 man-hours. On military work time is of more value than men, but about 200 men were the most that could be employed, so about three days was the minimum time of erection.

The Inglis was sometimes erected in one day on the true site, the Hopkins near it in a week on a diversion site, and the permanent civilian bridge a year or more later on the true site.

The military bridging practically ceased with the armistice. In both France and Belgium there were so many workless mechanics and laborers that the civilian authorities were encouraged to do as much as possible, and in the ensuing six months a great many of the permanent railway and highway bridges were replaced.

Fortieth Annual Convention of the American Water Works Association to be Held June 21-26, 1920, in Montreal

AT a recent meeting of the convention committee of the American Water Works Association, it was decided that the dates of the next annual convention should be June 21-26, 1920. It was decided at the last convention to hold the next assembly in Montreal, but the dates were left to the convention committee. The dates selected by this committee have to be confirmed by the executive committee of the association, but this no doubt will be largely a matter of form, as the convention committee is a sub-committee of the executive committee.

The five members of the convention committee met in Montreal last week and made final arrangements with the manager of the Windsor Hotel. Windsor Hall, adjoining the hotel, will be used for the exhibition. Access to Windsor Hall can be obtained from the hotel or directly from the street. Delegates entering Windsor Hall from the hotel will pass the rooms used as convention offices, and in order to reach the room where the papers will be read, the delegates will have to go through the exhibition hall. The convention hall will not immediately adjoin the exhibition hall, so the reading of papers will not be interfered with by the noise incidental to the exhibition.

The members of the convention committee declared that they were delighted with the arrangements that had been made, and that at no time in the history of the association have facilities been so absolutely ideal. The committee expect a big attendance of water works superintendents, contractors, consulting engineers and manufacturers from all parts of the United States and Canada. The conventions are attended every year by nearly a thousand members and guests, and it is thought that next year's convention at Montreal may prove to be a record-breaker, as a number of very interesting trips are being planned for the entertainment side of the program, and special effort will be made to have interesting papers, including a number of papers on Canadian work.

The convention committee have appointed a local committee on arrangements, consisting of a number of Montreal and Toronto members of the association, with H. G. Hunter, of Montreal, as chairman.

Association of C. B. & C. I.'s Proposed Constitution

AS a result of several months' thought and study, and after a large number of conferences with many members of the association from coast to coast, J. P. Anglin, president of the Association of Canadian Building and Construction Industries, has perfected a draft of proposed constitution and by-laws for the association. Last December the national council appointed Mr. Anglin as a committee of one to carry out this work. The constitution as prepared by Mr. Anglin has been submitted to the various members of the council, and while it has not yet been officially adopted, as no letter ballot has been sent out, a great many of the members of the council have expressed their approval, and it is thought that the constitution will be adopted with few, if any changes.

The constitution as prepared by Mr. Anglin consists of sixteen articles, covering respectively name, purpose, membership, annual fees, meetings, government and election, officers, duties of officers, executive committee, committees, order of business, expulsion and discipline, audit, seal, arbitration, and amendments.

The objects of the association are stated to be: (a) To promote better relations between the members on the one hand; and owners, architects and engineers on the other; (b) To establish and maintain standard methods of practice between members within the industry; (c) To acquire, preserve and disseminate valuable information concerning the industry; (d) To extend construction and improve conditions in the combined industry; (e) To co-ordinate the units of the industry in its producing, manufacturing, distribution, professional and constructive activities, thereby increasing its efficiency and extending its usefulness, to the end that the industry shall be established.

The membership is divided, as planned at the conference in Ottawa last November, into three sections: (a) General contractors and contracting engineers; (b) trade and sub-contractors; and (c) supply firms, manufacturers and producers of building materials and plant. Each section may be further sub-divided.

Two classes of membership are provided for: Direct,

or individual membership; and indirect, or collective membership. The latter comprises the membership of existing local builders' associations, contractors' sections of local boards of trade, etc. Such bodies are to pay an annual per capita fee of $5, minimum payment from any association to be $50. These bodies to be allowed one representative at each annual or special convention of the association for each $50 paid in fees.

The dues for individuals are to be $50 per annum for firms doing less than $500,000 business annually, with additional tax of $50 per annum for each additional $500,000 of annual business. The fiscal year commences October 1st, 1919, and all fees for the current year are to be considered as having been due upon that date. Members can resign at any time if their current dues have been paid.

The affairs of the association are to be managed by a national council, consisting of 45 members to be elected at the next convention of the association, which is to be held at Chateau Laurier, Ottawa, January 27th to 30th, 1920. Fifteen of these (according to the highest votes obtained) are to serve for a term of 3 years, 15 for 2 years, and 15 for 1 year, and thereafter 15 will be elected annually to serve a term of 3 years.

For the purpose of ensuring an equitable representation in the council, 5 councillors are to be elected from each of 9 electoral districts. These districts are as follows: District No. 1 (headquarters district)—Province of Ontario outside of District No. 2; District No. 2—City of Toronto and adjoining territory within a radius of 25 miles; District No. 3—Province of Quebec outside of District No. 4; District No. 4—Montreal and adjoining territory with a radius of 25 miles; District No. 5—Maritime Provinces; District No. 6—Manitoba; District No. 7—Saskatchewan; District No. 8—Alberta; and District No. 9—British Columbia.

In additional to the 45 members mentioned above, the chairman and secretary of each of the three main sections of the association are to be members of the national council. The president, two vice-presidents, honorary secretary and honorary treasurer are to be elected by the national council from among their number. There is to be an executive committee consisting of the officers of the association and the chairman of each of the three main sections. The national council is to direct the affairs of the association between annual conventions and the executive committee is to direct the affairs between the meetings of the national council.

RECENT PUBLICATIONS

A Public Building Group Plan for St. Louis.—Issued by the City Plan Commission, St. Louis, Mo.; 16 pages and cover, 8 by 11 ins.; illustrated.

Platinum Situation in Canada.—By J. J. O'Neil. Published by the Geological Survey, Ottawa; 15 pages, index, folded map and cover; 6½ by 9¾ ins.

Silurian Geology and Faunas of Ontario Peninsula and Manitoulin and Adjacent Islands.—By M. Y. Williams. Published as Memo 111 of the Geological Survey, Ottawa; 188 pages, index, folded map and cover; 6½ by 9¾ ins.; illustrated.

Cole Pitometer System.—Reprint of paper read at the last annual convention of the American Water Works Association by Geo. C. Andrews, water commissioner of Buffalo, N.Y., on "Reduction of Water Consumption by Means of Pitometer Survey and House Inspection."

The Zone Plan.—Cloth bound book, 82 pages and cover, 6¾ by 10¼ ins.; published by City Plan Commission of St. Louis, Mo.; contains a number of illustrations and numerous folded maps printed in several colors. Harland Bartholomew is engineer of the commission.

Fair Average Prices in Cost of Reproduction and the Trend of Prices After the War.—By Morris Knowles, consulting engineer, Pittsburgh, Pa., and Windsor, Ont. Reprint of paper prepared for the New Jersey Utilities Association; 15 pages and cover; 6 by 9 ins.; illustrated.

Summary Report, 1918, Part D.—Issued by the Geological Survey, Ottawa; 15 pages, index and cover; 6½ by 9¾ ins.; includes reports by E. L. Bruce, F. J. Alcock and W. A. Johnston on various districts in Manitoba, including report of the superficial deposits and soils of the Winnipegosis area.

Summary Report, 1918, Part E.—Issued by the Geological Survey, Ottawa,; 32 pages, index and cover; 6½ by 9¾ ins. This booklet contains reports by E. R. Faribault and A. O. Hayes on investigations in Nova Scotia and New Brunswick, and report by A. Anrep on peat investigations in New Brunswick.

Summary Report, 1918, Part C.—Issued by the Geological Survey, Ottawa; 48 pages, index and cover; 6½ by 9¾ ins. Contains reports by F. H. McLearn, J. A. Allan, B. Rose, D. R. Dowling and J. Stansfield, on geology of various districts in Alberta, gasoline and natural gas in Alberta, and surface deposits of southern Saskatchewan.

Load Concentrations on Steel Floor Joists of Wood Floor Highway Bridges.—By T. R. Agg, highway engineer, and C. S. Nichols, assistant director, of the Engineering Experiment Station of Iowa State College of Agriculture and Mechanic Arts; issued as Bulletin 53 of the Good Roads Section of the Station; 32 pages and cover, 5¾ by 8½ ins.; illustrated.

Road Material Surveys in the City and District of Montreal, Que.—By Henri Gauthier. Published as Memo 114 of the Geological Survey, Ottawa; 47 pages, index, folded map and cover, 6½ by 9¾ ins. The booklet includes discussion of the conditions affecting road construction, the geology of the district, road materials (bed rock, field stone, sand and gravel) results of laboratory tests, list of and data concerning deposits of bed rock and field stone. It is illustrated by a few views of local quarries.

The next convention of the International Association of Fire Engineers, which is to be in Toronto, will probably be held in June, 1920. It will be the first time in 25 years that this association has held its annual convention in Canada.

A series of lectures on municipal government will be given this winter at McGill University. These will deal with various phases of the subject, including municipal government in Canada, Europe and the United States. The lecturers are Senator L. O. David, Dr. H. L. Brittain, Thomas Adams, C. R. Woodruff, Dr. J. A. Hutchinson, Frederick Wright, Oscar Moran, K.C., C. J. Yorath, C.E., Thos. Bradshaw, W. D. Lighthall, K.C., and Howard S. Ross, K.C.

G. A. Crain, of Ottawa, honorary treasurer of the Association of Canadian Building and Construction Industries, has issued his report covering (1) the Ottawa conference, November 26th to 28th, 1918, and (2) the period from December 1st, 1918, to September 30th, 1919. During the first period there was collected $1,060.34, and the expenditures amounted to $1,012.83. During the second period the receipts were $3,038.71 and the expenditures $2,777.03. The principal items of expenditure during the second period were the salary and expenses of the former paid secretary, A. S. Clarson, of Montreal, while the expenditures during the first period were entirely in connection with the general conference at Ottawa.

MOUNTAIN HIGHWAYS AT HAMILTON, ONT.

Report Submitted by Noulan Cauchon, of Ottawa, Plans Access to Stadium and Park Development with Ruling Grade of Three Per Cent.

AT the request of the city council of Hamilton, Ont., Noulan Cauchon, of Ottawa, consulting engineer and town planner, has presented a report outlining the development of the "Mountain Top" and planning highway approaches. Mr. Cauchon's report is accompanied by a plan showing a 3% grade to the proposed stadium and park development on the heights overlooking Hamilton. Following are excerpts from Mr. Cauchon's report:—

The Mountain Park of Hamilton is a rare natural health resource of exhaustless value to its citizens. It is the city's great playground—its training camp of potential energy and efficiency. Town planners and sociologists, all those concerned in the welfare of the public, no longer look upon parks as mainly ornamental features to a city, but as being of essential economic necessity in fostering and sustaining the development of human energy and efficiency in the rising generations, who are the citizens and workers of to-morrow. The mountain face park stretches for five miles along a populous area, but is separated from it in large measure by a railway barrier which denies to much of this population the free enjoyment, the recuperation and enhancement that is within its gift, and theirs by right.

Lack of easy access for attaining its benefits, lack of ease in surmounting, its almost impassability to normal traffic seeking its summit, have deprived this marvellous asset from benefiting the dwellers at its base and from fostering the expansion of life upon the very attractive and desirable tableland stretching back from its summit.

Railway Tracks Retard Development

The obstacle retarding development has been primarily the railway trackage upon and along a considerable stretch at the base of the mountain, with level crossings at rare and distant intervals—instance the distance of two miles from Wentworth to Kenilworth Ave., with only one, a level, intermediate crossing over the multiple tracks of the Toronto, Hamilton & Buffalo Railway at Ottawa St., and at that within half a mile of one end of this stretch, and on the Grand Trunk Railway Co.'s mountain line, only a level crossing about opposite the previously mentioned one, and one other, also level, approaching "incline." This abnormal state of affairs, further, has prevented the adequate development of roads for access and for overcoming with reasonable grade the declivities within the physical limitations of the site, the legal road allowances, moreover, having been largely projected straight up the hill at impossible angles.

New Road System

A system of roads has been devised and their grades determined to facilitate the transmission of city traffic to and from the mountain top. Moreover, this road system will enable access for the enjoyment and for the further development of the park, as such, and of its amenities. An easy and ruling uniform grade of 3% has been obtained not only throughout the main arteries, but also realized throughout the minor tributaries, this notwithstanding the necessity of adjusting numerous road junctions within the limits of this grade, and of finding fortunate turning points throughout free from the large areas of steep side hill. The subsequent work of building these roads will in general not entail any abnormal cut and fill beyond the usual well-balanced cross-section. There will be some heavy cutting at the approach to the summit, where routes have been concentrated from the various tributaries into one main deep portal through the brow of the mountain in the hospital grounds.

Recommends Immediate Trail Construction

I strongly recommend, as a means of enabling the public immediately to realize their heritage in the park, that a selection from the grades forthwith be opened progressively as narrow footpaths to begin with, thus giving prompt access for inspection and use by the citizens, that they may see and understand the problem and its solution; also that they may begin to enjoy the wide vision of city and hills and valley and lake, and determine to their satisfaction the needed progression in widening the trails into arterial highways.

Attention is drawn to the manner of road junction that eliminates or reduces to a minimum what are known as "collision points," and also to the advantages derived from making turning points level, so compensating for curvature and diminishing resistance to pull; in other words, increasing the tractive capacity and the loads which may be hauled up these hills with any given power.

The Railway Tracks

The elimination of the railway trackage within and along the base of the Mountain Park is now under consideration by the Dominion Railway Board. For the purposes of this highway report these tracks are taken as they stand and under or over crossings of the railway suggested, as seem necessary under the circumstances and merits of the case, to maintain a ruling grade of 3%.

Justification for Ruling Grade

The adoption of this 3% ruling grade claims justification by factors of height, distance, haulage, capacity, climatic effect on surface, and the exigencies of pavement, of ideal residential area development, of attainment of park facilities—in sum, justification on the broad and comprehensive principle of civic enhancement and amenity.

Grade Separation

Of the two grade separation schemes heretofore considered by the city in relation to James St., I hold the alternative one of track depression as therein submitted to be the lesser evil of the two, in the city's interest, but even at that not depressed enough.

Under the modern dispensation of motor transport, a city should claim the right to protection of its factor of haulage efficiency, the ruling grade of its arterial highways, as determined within and without. In grade separation schemes through cities, the principle of respecting the ruling grade of the arterial highways and main streets should prevail on its merits of paramount public importance. To date, the tendency has been unquestionably to allow railways their ruling grade, adjusting that of the community as of minor importance, usually at 5%. Where economically possible, both ruling grades should be attained; otherwise the disabilities, like the whole costs, be distributed proportionately on their merits.

Further, whilst the grade of a street at a given point may be altered without lessening its ruling grade of the whole artery, yet it may cause locally serious disfigurement, depreciation of property values and of amenity.

In a comprehensive scheme of grade separation throughout Hamilton as may be submitted by the railways in balance against their removal, as is now sought by the city, there should be no question of kinking or humping a number of the principal streets of the city.

Advocates Removal of Tracks

This dissertation on comparative evils in no way alters my firm conviction that the proper and most advantageous solution for the city is to labor and negotiate towards their removal, saving such spur connection as may be necessary for maintenance of existing industrial service.

Grade separation, at its best, will eliminate but life danger, one only of the many afflictions that evolve from the strenuous activities of railways in the wrong place—injuriously affecting general well-being.

Poor's Manual will give you detail as to the worthy stature enjoyed, as a private corporation, by the Toronto, Hamilton and Buffalo Railway, and, let me add, through able, courteous and effective management—yet the city of Hamilton embodies an aggregate corporate entity of about

a hundred millions of dollars, representing public interest and as of paramount importance, where a benefit or an injury to a part is a benefit or an injury to the whole.

The 3% Highway Grade

The city is well within right and fairness in claiming reservation for itself of a 3% grade as against the 1% prevailing on the railway. The 3% grade adopted for this sytem of roads was arrived at by first determining the objective points and their relative elevations. This means by finding a central common controlling point of highest city elevation and joining it in the most direct and continuous manner with the lowest central controlling common point of mountain tableland elevation.

Climatic Conditions

The climatic conditions of generally mild winters, little snow, occasional rain and intermittent freezing result in frequent periods of glare ice on the mountain grades.

I have observed the general difficulty, often impossibility, and the ever-constant danger of negotiating the existing mountain grades—even motor chains unable to grip —and there is a chapter of fatal accidents to their discredit.

Surface Paving

Steep grades as now existing preclude satisfactory paving and efficiency in maintenance. Observation of traffic on John St. in the vicinity of the Arkledun turn, in bad or frosty weather is convincing proof of the futility of smooth permanent pavement on such heavy grades.

Observation of the lack of pavement under similar conditions, say, the Jolley Cut, shows that rain and drainage scour the unprotected surface and materially heighten its resistance to traffic.

Three per cent. grades would allow of permanent pavement to the minimum of inconvenience and danger and maintenance, to the maximum of comfort, safety and tractive efficiency.

Importance of Motor Traffic

The advent of mechanical transport has brought the problem of highway haulage under the same principles for economy and efficiency as heretofore prevailed for railways and upon which railway grade reductions are figured and justified.

The "Good Roads" efficiency for mechanical transport is the beginning of what might be termed the democratization of transportation—independence for the individual.

Whoever owns a boat may place it upon water with the freedom of the seas, and compete in the markets of the world. Whosoever owns a motor truck may, in the near future, place it upon a national highway and compete freely for the traffic of the country. This already obtains between Toronto and Hamilton as the index of coming expansion, and is welcome warning to the community that it carefully nurse the efficiency of its public highways.

There are said to be 5,000 locomotives in Canada, also 250,000 automobiles (including motor trucks). If the number of locomotives be multiplied by 300, it would represent 1,500,000 h.p. hauling all the passenger trains and freight of Canada. If the autos and motor trucks be averaged at 20 h.p., it would represent 5,000,000 h.p. on our highways.

Trailers in the Future

Now, whilst this illustration is given with the candid admission that auto power to date is largely light traffic, yet it points to the growing power on our highways and to the future doubling, trebling, quadrupling, within measurable grasp, of motor traction and the economic advantage of its use with trailers.

Whilst disclaiming any inherent virtue in any particular grade, except in its relation to the economics of any particular case, on its merits, the fact stands out that the future of highway transportation enjoins upon cities the responsibility of determining at least the best ruling grades that its circumstances afford, and justifies communities in claiming that such be absolutely respected in any intersection with any railway or other transportation device.

Reverting to Hamilton: A good five-ton motor truck will barely haul itself and load up the "Jolley Cut." The same motor truck would haul itself and load and three trailers up the proposed mountain grades, in all 15 to 20 tons, according to surface conditions.

If the building up of the Mountain Top as a suburb be considered, this means cutting to a third, or better, the cost of delivering up there all bulk materials, brick, sand, lumber, coal, etc. This means cheaper "housing" and keeping down the capitalization of the "home."

These 3% grades also mean that degree of efficiency in the radiation of Hamilton's highways to all the country between it and Lake Erie; increasing the quantity and lessening the cost of produce receivable, lessening the cost of long haulage and expediting the city's industrial production.

Town Planning and Arterial Highways

The synthesis of organic town planning is, first, solution of the railway problem; secondly, determine arterial highways; thirdly, zoning, that planning may be to purpose.

Regarding the great provincial arterial highways and their subsidiary collection and distribution of the traffic they carry, it may be well to note that the motor world is coming to accept the 5-ton truck as the standard haulage unit.

This truck can be unwisely overloaded to 7 tons; it can be made advantageously to haul 4 trailers on level roads, an aggregation of 25 tons. Individual or special trucks or trailers will be loaded with boilers, machinery, and other items exceeding 10 tons.

It is manifest that a city cannot rovide all its pavements for the indiscriminate admission of such loads, and must determine certain routes throughout its mesh of streets for heavy haulage with special foundation and maintenance for same, or risk having all its pavements in a generally crushed and disintegrated state.

Anticipating such routing (a further argument for zoning), I have endeavored to provide a level road across the base of the park, south of the present Toronto, Hamilton & Buffalo trackage, as a collecting channel for the main north and south heavy arteries, which are about half a mile apart—Kenilworth, Ottawa, Gage, Sherman, Sanford, Wentworth, Victoria, Wellington, and the principal streets between this latter to and including James, in the present report. These arteries will no doubt in time come to be dedicated for heavy traffic bearing and be provided with deep concrete bases.

May Expropriate Railway's Land

A peculiar situation arises in connection with the mountain base road referred to, being that not only would an extension of Kinnear Yards, as previously attempted, prevent the carrying out of this provision, but that the further use of the adjacent property by the Toronto, Hamilton & Buffalo Railway Co., and now owned by them, would also prevent proper access to the whole Mountain Road system for nearly a mile and a half between Ottawa and Sanford Aves.

It may be that this land outside of the right-of-way which may be taken by franchise is still but railway real estate, and, failing its having been authorized by the Dominion Railway Board as "extra land," can be taken by the city under the ordinary provisions of Municipal Act for highway and for park purposes. In any case, the matter should be submitted to the Dominion Board for discussion and authorization of the road system as road diversions, and for protection of necessary supporting physical conditions for accomplishing same.

Park Development

The topography of the Mountain Park is such that its natural treatment will be one of terraces. The road system proposed for economic purposes so happens to be admirably adapted to further this particular style, for which the park contains many magnificent opportunities.

The street railway tracks on the two main grades from James and from Kenilworth Streets should, where within the park, be at the curbs, in order that passengers may enter and leave anywhere without slowing or interrupting the passing motor traffic.

PRESSURES IN PENSTOCKS CAUSED BY THE GRADUAL CLOSING OF TURBINE GATES*

By R. D. Johnson
Consulting Engineer, New York City; Formerly Chief Engineer, Ontario Power Co., Niagara Falls, Ont.

MR. GIBSON'S remarkable paper deserves the closest attention on the part of all who are interested in the water-hammer problem.

He remarks that the theory has not been experimentally confirmed, but it is so obviously complete and correct as scarcely to need such confirmation to establish strong faith in its accuracy.

The writer has been especially interested in a completely correct treatment of this subject, in order to be able to fix the limits of K within which his pressure-time curve, previously presented to the American Society of Civil Engineers, is sufficiently accurate for practical purposes.

It is found, fortunately, that this smooth curve†, log. $x = n$ log. $[T/(T-t)]$, is applicable with much precision to such a wide range of conditions as to justify its use for practically all the water-hammer problems arising in connection with the design and operation, under ordinary heads, of water turbines, when properly regulated.

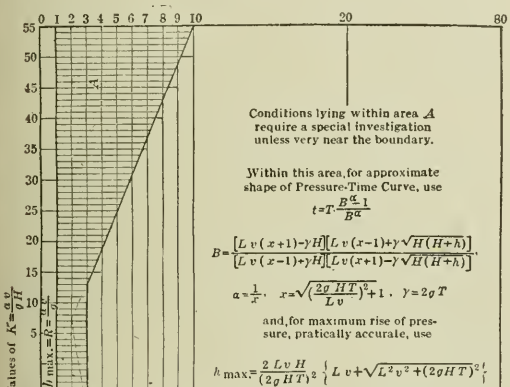

Conditions lying within area A require a special investigation unless very near the boundary.
Within this area, for approximate shape of Pressure-Time Curve, use
$t=T\frac{B^{\alpha}-1}{B^{\alpha}}$
$B=\frac{[Lv(x+1)-\gamma H][Lv(x-1)+\gamma\sqrt{H(H+h)}]}{[Lv(x-1)+\gamma H][Lv(x+1)-\gamma\sqrt{H(H+h)}]}$
$\alpha=\frac{1}{x}$. $x=\sqrt{(\frac{2gHT}{Lv})^2}+1$. $\gamma=2gT$
and, for maximum rise of pressure, pratically accurate, use
$h_{max.}=\frac{2Lv H}{(2gHT)^2}\{Lv+\sqrt{L^2v^2+(2gHT)^2}\}$
or $=\frac{HK}{8n^2}\{K+\sqrt{K^2+16n^2}\}$
Within this area, for maximum rise of pressure, use
$h_{max.}=\frac{H}{2}\{K^2r^2+2K-\sqrt{K^2r^2(K^2r^2+4K^2+4)}\}$
$r=\frac{n-1}{n}$
Values of $K=\frac{av}{gH}$
Values of n

FIG. 12—CHART OF LIMITATIONS FOR WATER-HAMMER PROBLEMS

By differentiating Mr. Gibson's equations, it is possible to express rigidly correct values of the tangents to the true pressure-time curve at (a), the beginning of gate closure (b), the end of the first interval, and (c), the beginning of the second interval.

Using Mr. Gibson's nomenclature, with omission of subscripts, that is, putting $R_0 = R$, and $S_{T1} = S$, and $H_0 = H$, these tangents may be expressed as follows:—

tan. (a) $= 2RH/(R+2H)T$

tan. (b) $= [R^2(T-T_1)/HT^2]\{(S+2R+2H) \div [S(S+4R+4H)]^{1/2}-1\}$

tan. (c) $= [R^2(T-T_1)/HT^2]\{[S(Z+1)+2R+2H] \div [S(S+4R+4H)]^{1/2}-(Z+1)\}$

where $Z = 4H^2T/R(R+2H)(T-T_1)$.

It is clear that the effects of vibration in the water column, due to elasticity, tend to disappear when the conditions are such that tan. (b) and tan. (c) approach equality; also, if the change in the rate of pressure rise at the beginning of the second interval, due to the effect of the returning wave, is less than the rate at which the pressure begins to rise

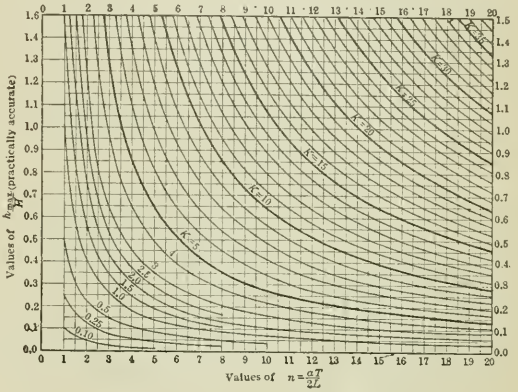


FIG. 13—WATER-HAMMER CHART FOR UNIFORM GATE CLOSING

when the gate starts to move, it is evident that the conditions are such that the effect of elasticity is rapidly dying out, and that it should be scarcely appreciable during the remainder of the closing period.

If, then, tan. (b) — tan. (c) < tan. (a), the writer's Equation (7), above referred to, or the maximum value of h, given by the so-called Alliévi formula, may be used with much precision.

This may be shown to be the case when.

$$K > 2/[(3r^2+1)^{1/2}-1] \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where r is the ratio $(T-T_1)/T$; and $K = R/H$.

Equation (1) marks the lower limit for values of K, below which it is not safe to use Equation (7). To find the upper limit of safety, for values of K, it is noted that, as H decreases, the pressure-time diagram passes through a transition stage where an ogee form of curve most closely approaches to a straight line, and, that thereafter, as H continues to decrease, Equation (7) begins to produce a curve sharply upturning and curving one way, for the most part, as its extremity reaches toward infinity, thus leading to serious errors in its results.

By trial, assisted by arithmetic integration, it has been noted that, for large values of n, the head may be reduced to about one-half the value which produces the approximate straight-line diagram.

To find this point we may equate the value of $h_{max.}$ in the so-called Alliévi formula to the value of the pressure rise found at the end of a straight-line pressure-time diagram, enclosing the same impulse area, and solve for the value of H.

In this way it is found that

$$K = 3n \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

(where n is the closing time expressed in intervals), and Equation (7) may be used so long as

$$K \leq 6n^2/(n+1) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

which, for large values of n, is nearly twice as great as the value given by Equation (2), but which becomes equal to 3, as it necessarily must, when n becomes unity.

*Discussion (presented to the American Society of Civil Engineers) of Norman R. Gibson's paper (see September 4th and 11th issues of *The Canadian Engineer*).

†The derivation of this curve, Equation (7), is given in Transactions, Am. Soc. C.E., Vol. LXXIX, p. 280.

Equation (3) marks the upper limit for values of K, above which it is not safe to use Equation (7). Therefore, the smooth logarithmic curve given by Equation (7) may be applied only when K lies between the values given in Equations (1) and (3), and preferably, also, when n is not less than three intervals.

Fig. 12 shows that Equation (7) covers a very wide range of conditions, and, furthermore, in the design of a water-turbine installation, the values of V and n should, when possible, be adjusted so that Equation (7) will be correctly applicable; and particular attention should be given to the limitations set forth in Equations (1) and (3), in order that the speed of the water unit may be regulated most effectively.

The expressions for the tangents (a), (b) and (c), are rigidly accurate, and form a substantial basis for further possible study; for example, if tan. (c) be equated to zero, the limiting value of n may be found when the maximum pressure-rise occurs at the end of the first interval. This is thus found to be the case, always, when

$$n > (4K^2+8K)/(12-K^2-K^3) \quad \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

It is seen that this expression is positive and finite only so long as $K < 2$; therefore, K must always be less than 2, in order that the maximum rise shall occur at this point. It does not follow that this will be the case merely because $K < 2$, unless Equation (4) also applies.

In support of Mr. Gibson's work by experimental observation, it may be pointed out that much information is available for cases which occur within the limits here set forth, and, inasmuch as his complete work incidentally includes such cases, it may safely be predicted that no error in theory will be discovered by experiment.

The writer, himself, has confirmed Equation (7) a great many times, under a variety of conditions, in the past twenty years, and, because of such confirmation, he was not led, from practical necessity, to a more thorough investigation of the theory.

In conclusion, the writer wishes to urge those interested to a further study of the limits here graphically presented, with the idea either of confirming or improving them, because it is not profitable to resort to the very tedious processes incident to the methods presented by Mr. Gibson, except when a comparatively simple formula is inapplicable. The chart, Fig. 12, indicates that this is very rarely the case, and practically never need be, with proper care in the design and operation of any water system.

It is interesting to note that Mr. Gibson's methods may be used to work out a system of perfectly general cases, thus enlarging, indefinitely, the scope of such diagrams as he has presented, which are based, merely, on a specially selected set of data.

This is made possible by simply substituting in his scale of ordinates, values of the ratio $(h_{max.}) \div H$ in place of (h_{max}), and substituting for the values of H, written on the curves, the values of K.

This trifling change, it will readily be seen, will make such diagrams applicable to an infinite variety of special cases.

In this manner, the chart, Fig. 13, has been roughly prepared, and, for the range of values covered, it is not necessary to resort to formulas.

All combinations of a, V and H which produce a constant value of K must invariably result in a definite single value of the ratio $(h_{max}) \div H$ for each selected value of n. Therefore, in fact, each point of the chart covers, theoretically, an infinite variety of conditions.

In the use of the chart or simple formulas to replace the accurate but tedious methods, it should be borne in mind that it is not ordinarily practically necessary that the agreement should be perfect, because, as Mr. Gibson has shown, the shape of the curve is so sensitive to the vagaries of the gate motion, in closing, as to make it almost out of the question to reproduce, experimentally, any definitely selected shape of curve; so that, after all, the element of judgment must enter as usual.

The effects of velocity-head and friction-head have been neglected in the preparation of Figs. 12 and 13. These factors are nearly always of minor importance, as affecting the rise of pressure, but, nevertheless, they may be taken into account by means of arithmetic integration in special cases where great accuracy is thought to be warranted. These effects, at any rate, cannot be included in a usable formula, covering the whole range of the charts.

DEAN MITCHELL INSTALLED AT TORONTO

Discusses Trend of Scientific Education and Indicates Probable Broadening of the Curriculum—Greater Attention to be Paid to Certain Civil Engineering Subjects

DECLARING that the aim of university education to-day should be to produce broadly educated, cultured gentlemen and good citizens, even before the production of trained technologists, Brig.-Gen. C. H. Mitchell, C.B., C.M.G., D.S.O., delivered an interesting address on Wednesday of last week, at Convocation Hall, Toronto, at his installation as dean of the Faculty of Applied Science and Engineering of the University of Toronto.

The new dean was introduced by the president of the university, Sir Robert Falconer, who, after speaking with high appreciation of the work of the two former heads of the faculty—the late Dean Galbraith and the retiring Dean Ellis—referred to the development necessary if the engineering faculty is to march with the times.

University Must Anticipate Demands

In introducing Dean Mitchell, Sir Robert said: "On the new dean rests a particularly heavy responsibility, and I believe we have the man to shoulder the responsibility." Sir Robert then spoke at length of the brilliant war record of Dean Mitchell, and said that the qualities which had made him so successful in war, were those which would make him successful as dean. In conclusion, Sir Robert expressed his gratitude to Dean Mitchell for his acceptance of the responsibilities attaching to his new office, and, as president of the university, formally asked him to make his inaugural address.

Dean Mitchell, who rose amidst enthusiastic applause from the students and members of the faculty present, commenced by paying a warm tribute of appreciation and affection to Dean Ellis and to the memory of the late Dean Galbraith, to whose splendid work he attributed much of the success which the Faculty of Applied Science has already attained.

Taking as the subject of his address, "The Future of Applied Science," Dean Mitchell declared that this rests with all who are concerned with the development of this great country, not only in the actual processes, but equally in the education of the young men who are to participate in its development. It is not sufficient to "wait and see" what the trend of events will be, but it is for the university to anticipate the requirements and demands and to have ready the highly educated and trained men to meet the country's needs. The highest function of a university, he declared, is to lead the country in thought and action.

Influence of the War

Turning to the influence that the war has had upon the lives and ideals of men who have served in it, the speaker referred to the important part that engineering science played in the war, recalling the words of Lloyd George early in the struggle, that it was an engineer's war. Dean Mitchell, in proof of this, reviewed some of the contributions of science to the success of the struggle, referring to the elaborate developments in trench warfare, in artillery, in the air and under the sea.

"There is a new world ahead in applied science," he declared, and pointed out that Canada has realized the greatness of her resources during the war, and her ability to apply

them to her own life and the life of the Empire. The speaker saw ahead a great resumption of manufacturing and industrial activity in the country and a great need for the services of many applied scientists and engineers.

Discussing the educational requirements to meet this demand, Dean Mitchell saw a greater need for training in the industrial group of electrical, mechanical, chemical and metallurgical engineering work. An interesting fact is observable in the present year at the university, where one-quarter of the new students in the engineering faculty are in chemical engineering.

Dean Mitchell then discussed the tendency of scientific education to become too specialized, though this had not been the case so much in Canada. He declared that the first principle in applied science education is undoubtedly that a sound general education should be obtained as a foundation.

"Thirdly,—Educated Technologists"

"Considering the entire education of the young engineer," he continued, "there seems only one conclusion as to the necessity of to-day in this young country at its critical stages of development. For nowadays we require not only technologists in the form of applied scientists or engineers, but we want men who are more than that—we require to produce men who by their college education will be: First, broadly educated, cultured gentlemen; second, good citizens of Canada and leaders of influence within the community in which they may be placed; and after this, third, thoroughly educated technologists in whatever branch of applied science they may chance to enter."

How to obtain these results next occupied the attention of the speaker, and he referred to the returned soldiers present among the students, who would look to have the great principles of science that played so important a part in the war, applied in an even greater measure to the problems of peace. The curriculum under which the students studied would need radical changes designed primarily to broaden the present educational outlook of the "science" student.

Greater Attention to These Subjects

Referring to the actual engineering teaching itself, the speaker showed how greater attention will have to be paid to such subjects as municipal and sanitary engineering, transportation and highway engineering, irrigation engineering, aerodynamics, shipbuilding, architecture and town-planning.

In order that the science student may go out into the world a practical man in touch with the full life of industry, Dean Mitchell thought that such questions as the philosophy of values and costs, the psychology of labor and industrial problems, should be taken up during his training. If the engineer and the applied scientist are to take their places in the community, they must be trained to appraise correctly what men consider worth while, he declared. Dean Mitchell concluded by impressing upon his audience the fact that character and personal qualities rank above mere technical knowledge.

"A hardening solution for concrete floors that prevents dusting is made from sulphate of alumina and acidulated water. To 10 gals. of cold water (as soft as possible) add slowly 1 fluid ounce of commercial concentrated sulphuric acid. Heat the liquid to boiling point and stir in gradually 25 lbs. of commercial sulphate of alumina. When this solution has been effected let it cool and settle for several hours. Strain through muslin. The concrete surface to be treated must first be swept and thoroughly washed. After drying, the hardener is put on, preferably with a broom. Four applications are recommended; three consist of varying dilutions of the hardener with water, while the fourth is the hardener used 100% straight. These first three solutions are respectively: (1) 30 hardener to 70 water, (2) 50-50, and (3) 70 hardener to 30 water. Allow an interval of twenty-four hours between successive applications. The above quantity suffices for the complete treatment of an area of from 50 sq. yds. to 100 sq. yds., depending upon the porosity of the surface treated."—From the Municipal Engineering and Sanitary Record, England.

THE PROSPECTS OF RAILROAD ELECTRIFICATION

By F. H. Shepard
Director of Heavy Traction, Westinghouse Electric & Manufacturing Co.

WORLD-WIDE shortage of coal during the great war has emphasized more clearly than ever the necesssity of fuel economy in industry, while the present shortage of labor and the certainty of its continuing scarcity throughout the reconstruction period, forms another most serious problem. But fortunately we have at our disposal a means that will greatly assist in alleviating both of these conditions, namely—electrification.

The use of electricity in industry saves both fuel and labor. This fact is recognized throughout the world to-day, and in order to secure these advantages, practically all of the nations are now considering plans for the electric generation of power. In England, Belgium and France, among others, these plans are being prepared by official commissions, so a tremendous activity in electrical power development may be expected with the stabilization following the advent of peace. In all cases, the ideal in view is a broad one: To use electricity for all possible power purposes, including railroad operation.

Advantages of Electrification

The operation of the railroads will naturally form an important part of any program of general electrification, for in almost every country the railroads form one of the largest users of fuel and labor. Nor are the advantages obtained from railroad electrification limited solely to economy in fuel consumption and the more effective use of labor. Among others, the following may be mentioned:—

1.—Greater speed of movement for the heavier trains, due to the fact that electric locomotives can be made much more powerful than the largest steam locomotives.

2.—Greater nicety of control.

3.—Increased traffic capacity of existing tracks, terminals, grades, tunnels and other points of traffic restriction. When electricity is used, heavier trains can be operated at higher speeds and less time is consumed at terminals and in yards.

4.—Operation where the use of steam is impossible or objectionable, as in long tunnels.

5.—Independence of weather conditions, since the electric locomotive is not affected by cold weather.

6.—More reliable operation, as proved by the statistics of all existing electrifications.

7.—More effective use of all rolling stock, due to more expeditious movement of traffic.

Those are some of the advantages that are now being obtained by the mere substitution of the electric locomotive for the steam locomotive, but they by no means tell the whole story.

Unlimited Inherent Possibilities

Consider electric illumination. When first introduced, the electric lamp supplanted a gas or an oil light because of certain advantages it possessed, and at first it occurred to no one that it would ever do much more. But within 30 years the electric lamp has revolutionized illumination and has given us our light-flooded factories, with their greatly increased production and safety, and our "Great White Ways" also.

The industrial electric motor is another case in point. At first it merely took the place of a steam engine in the factory. To-day, practically every machine has its own motor of specially selected characteristics, and feats of production are now possible that were undreamed of a generation ago.

A further example is the growth of our great city and interurban electric transportation service of to-day due to the substitution of the electric motor for the horse on street cars.

In other words, an electrical method will in the beginning take the place of an older practice because of some economic superiority. Then its almost unlimited inherent possibilities are developed, and in time results are accom-

plished that would be impossible at any cost with the older methods.

There is good reason to expect that the electric operation of the railroads is capable of a similar development and will in time revolutionize our present transportation methods and provide us with services we know little or nothing about to-day.

Conditions in United States

Since the United States has an abundance of coal, railroad electrification there has been determined solely by local conditions. Passenger terminal problems caused the electrification of the New York Central at New York and of the Pennsylvania at New York and Philadelphia. The limitations of the steam locomotive determined the electrification of the Baltimore Tunnel on the Baltimore & Ohio, the Cascade Tunnel on the Great Northern, the St. Clair Tunnel on the Grand Trunk, the Hoosac Tunnel on the Boston & Maine, and the Detroit River Tunnel on the Michigan Central. Examples of electrified railroads with freight as well as passenger service are the Norfolk & Western; the Chicago, Milwaukee & St. Paul; and the New York, New Haven & Hartford.

While the other electrifications are successful and interesting, the last three are more properly representative of general railroad electrification. The Norfolk & Western is an example of electrification under the heaviest conditions of freight traffic on a mountain grade. The Chicago, Milwaukee & St. Paul has in operation the longest continuous mileage in the world, and when completed will cross five mountain ranges. The New York, New Haven & Hartford has a very large movement of both freight and passenger traffic.

All three installations are successful and profitable and, when financial conditions are stabilized and the American railroad question settled, it is expected that all three will extend their electrified service.

In addition, there are sections of railroads, in various parts of this continent, where the present congestion of traffic or the availability of water-power warrants the early adoption of electric power. Under normal conditions of finance, as no engineering problems now remain to be solved, these possibilities alone promise extensive activity in the electrification of railroads for many years to come.

Conditions Abroad

Differing from North America, European and South American countries, with the exception of England alone, lack an adequate supply of fuel, but many of them, including Norway, Sweden, Switzerland, Italy, Spain and Brazil, have large amounts of water-power, while France has a moderate amount. These resources, combined with the high cost of fuel, make extensive railroad electrification in these countries inevitable sooner or later.

The neutral countries will probably be the first to undertake this work, Switzerland having a well-established program covering a term of years, while both Norway and Sweden are giving active consideration to definite projects.

In England, a considerable amount of electrification is in contemplation along with the general plan for the electrification of industry.

A French commission composed of government and railroad engineers have already visited the United States in order to familiarize themselves thoroughly with American practice.

The Italian government will continue their definite program as soon as financial conditions permit.

An official Belgian commission is already planning to rehabilitate with electric power at least a portion of the railroads destroyed by the Germans.

In Spain, Brazil and South Africa, railroad electrification is under active consideration.

It is evident, therefore, that the next decade will see a large amount of railroad electrification in almost every quarter of the world.

The next (second) general conference of the Association of Canadian Building and Construction Industries will be held in Ottawa beginning January 20th, 1920. The association will also hold a convention next month in Winnipeg.

RULES FOR DRAFTING PRACTICE

Cover Concisely Dimensions of Drawings, Allowable Scales, Character of Lettering and Many Other Points

SOME ten years ago H. N. Savage, then with the United States Reclamation Service, and now hydraulic engineer for the city of San Diego, Calif., drew up the following rules regarding drafting practice. They have been in use ever since on his projects, with excellent satisfaction, says Engineering News-Record, of New York:—

Drawings should conform to the following sizes, several sheets being used if necessary, supplemented with an index sheet:—

Out to out.	Inside border.
8 x 11 ins.	7 x 10 ins.
11 x 16 ins.	10 x 15 ins.
16 x 22 ins.	14½ x 20½ ins.
22 x 32 ins.	20½ x 30½ ins.
32 x 44 ins.	30½ x 42½ ins.

Drawings of 10-in. vertical dimension, inside border, may be made any length necessary over 15 ft.

Trimming lines for drawings should be drawn on each tracing and the tracing cut ¼ in. outside these lines. Paper drawings should be cut to the same dimensions as tracings.

Tops of drawings should orient with north cardinal point.

Maximum dimension of drawings should be horizontal.

Do not abbreviate any words on drawings.

Sufficient legends should be used to identify all parts of a drawing.

Drawings must be independently checked with a degree of accuracy commensurate with the importance of the work involved.

The initials of the persons who draw, trace and check a drawing should be shown in the lower left-hand corner thereof. Those of the checker should be affixed by him in writing; the others should be printed.

The names of the supervising and project engineer or engineer in charge should appear on all drawings, but may be printed on drawings not requiring approval. Drawings of projected work and drawings involving policy, after being signed by the project engineer or engineer in charge, and before construction is begun, must be submitted to the supervising engineer, and if they are approved separate prints will be furnished to the project or feature office. Approved tracings will usually be retained in the files in the supervising engineer's office.

The subject of the drawing should form the major feature of the title, as, "Lower Yellowstone Dam." Such words as "map," "plat," "sketch," "location," "proposed," etc., should not be used in titles.

Drawings accompanying correspondence should be stamped on the margin "Transmitted to .....with letter dated .....19..," or, "Received from..... .....with letter dated .....19..," appropriate name and date being written in ink.

Paper drawings and prints should be folded right side out to letter size, title on top.

Only a minimum amount of work should be done on pencil drawings which are to be traced. Whenever practicable, preliminary penciling should be done directly on the tracing cloth.

Every tracing, in advance of its making, should receive an appropriate title and project number. Project and supervising engineers' file numbers should be placed on the margin in the lower right-hand corner.

Lettering on drawings should be placed to be read from the lower right-hand corner of the drawing. Plain single-stroke letters should be used except on drawings requiring distinctions between different kinds of names. Liberal and uniform spacing should be provided between words. Inclined Gothic lettering should be used on structural and mechanical drawings; capitals for special emphasis and in titles; lower case for general description and notes. Lettering on drawings 11 x 16 ins. or over should be of sufficient size to be

legible when the drawings are reduced to one-half the original dimensions.

Contract drawings, except profiles, for photolithographic reproductions should be prepared for a reduction to about two-thirds the original dimensions, and to come down to a vertical dimension of 10 ins. between the border lines. Profiles should be prepared for reduction to one-half the original dimensions, with a vertical dimension of 10 ins. between the border lines. Where possible, two lines should be placed on a sheet. The horizontal scale of profiles should be made as small as practicable. Lettering on contract drawings intended for photolithographic reproduction should be in pencil, the final lettering being left to be put on in the director's office with standard type.

Drawings of land should show legal subdivisions or other co-ordinate lines referred to some fixed point, as section or quarter-section corners.

True north, also magnetic north if known, should be indicated on each drawing of land unless section lines are shown.

Vertical sections and elevations taken across a stream or canal should be shown looking downstream. Vertical sections and elevations taken along a stream or canal should, wherever practicable, show stream flowing from left to right. Stationing of profiles should, wherever practicable, increase from left to right of the drawing.

The direction of streams and of canals through structures should be shown by arrows.

Contours should be in 1, 2, 5, 10, 20 or 100-ft. intervals. Contours and figures showing their elevations should be in burnt sienna. Distinguishing contours should be of deeper color.

Graphic scales should be shown on each drawing. Following are approved scales:—

For maps and allied drawings, 10, 20, 40, 100, 200, 400, 500, 1,000 and 2,000 ft. and ½, 1, 2, 5 miles, and even multiples of 2 and 5, to an inch.

For engineering structures, ⅛, ¼, ½, 1, 3 and 6 ins. per foot, and 10, 20 and 40 ft. to an inch.

For mechanical and architectural drawings, 1/16, 1/18, ¼, ½ and full size.

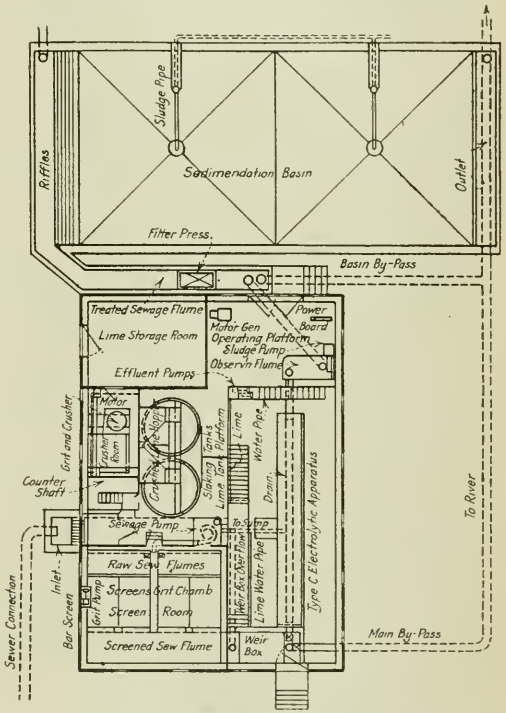
Following is a partial list of Canadian patents recently obtained through the agency of Ridout & Maybee, Toronto: Henry P. Fletcher, means for the conversion of water pastes into oil pastes by chemical and mechanical action; Jabez Muskett, hose couplings and hose attaching devices; Diaphone Signal Co., Ltd., metal bending and forming machine; Nile Testrup, methods of conducting high temperature reactions; E. O. Williams, slipways for the construction of reinforced concrete ships, barges and other floating structures.

The Portland (Oregon) Telegram announces the opposition of engineers of Multnomah County to the appointment of an eastern bridge engineer to design and construct several bridges in the city of Portland. The estimated cost of the bridge program is between $2,500,000 and $5,000,000. A number of Portland engineers appeared before the Board of County Commissioners and registered a protest against the plan to engage a Kansas City bridge firm to carry out the work. As a result of the protest, the Board of Commissioners asked the engineering societies of Portland to recommend an Oregon engineer who in their estimation is competent to undertake the entire program.

Two 25,000 k.w. steam-driven turbine units, which, when installed, will complete the largest steam-driven electrical installation in the Far East, are now being erected at Osaka, Japan, for the Osaka Electric Light Co. Located in an extensive industrial district, this company furnishes light and power to street railways, steel works, ship builders, copper refining plants, paper mills, electro-chemical installations and other industries. In 1908, the Osaka Co. installed three steam turbine units of 3,000 k.w. each. In 1910, two more units of like capacity were added, and in 1911 two, 5,000 k.w. units. The 25,000 k.w. units now being installed will bring the capacity of the plant up to 100,000 h.p.

OPERATING RESULTS OF "DIRECT OXIDATION" EXPERIMENTAL SEWAGE TREATMENT PLANT AT EASTON, PA.

IN November, 1917, the city of Easton, Pa., granted permission to C. P. Landreth, of Philadelphia, patentee of the "direct oxidation process" of sewage treatment, to construct an experimental plant for treatment of the city sewage. The plant was to have a nominal capacity of 1,000,000 gals. per day, and was to be installed without obligation on the part of the city. The plant was placed in operation shortly after May 1st, 1918. Tests of the experimental plant were conducted in December, 1918, by engineers of the State Department of Public Health, an 8-hour test run being made on December 4th, followed by a 24-hour test, starting at 8 a.m., December 6th. The results of these tests are given in a report by C. A. Emerson, Jr., chief of the Engineering Division of the Department. The matter following is an excerpt from this report:—



PLAN OF EXPERIMENTAL PLANT AT EASTON

The area tributary to the plant is divided into two distinct districts. The first is sewered on the separate system, contributing sanitary sewage only, while the second district contains combined sewers, contributing both storm water and sanitary sewage. A survey of the district indicated 585 properties connected to the sewer system as follows: 511 dwellings, 37 combined stores and dwellings, 10 stores, 2 office buildings, 3 hotels, 3 schools, 1 laboratory, 7 churches, 1 armory, 8 garages and 2 breweries. The order of the Federal Government closing breweries became effective four days previous to starting the test of the plant, hence the volume of manufacturing waste discharged from these breweries was much reduced.

The sewage received at the experimental plant appears to be a fresh, domestic municipal sewage of ordinary concentration and composition, and passes through a centrifugal pump before treatment.

The rainfall during the last part of November and the few days of December preceding the test was negligible.

The time of passage of sewage from the most distant house in the district to the sewage treatment plant is comparatively short, and probably does not exceed 1¼ hours. The low quantity of total solids, suspended solids and oxygen consumed indicate a relatively dilute sewage; the presence in appreciable quantity of nitrates and nitrites and the ratio between the organic nitrogen and the free ammonia contents show that the sewage is quite fresh as treated at the plant. The process of treatment at the plant consists of (1) coarse bar screens; (2) flat plate fine screens, ¼-in. circular openings; (3) grit chamber; (4) chemical treatment—3.720 lbs. lime per 1,000,000 gals.; (5) electrolysis; and (6) settlement.

Description of Plant

Sewage is diverted from 3 ft. by 4 ft. 6 ins. egg-shaped combined sewer through a 12-in. pipe, a concrete dam having been constructed in the main sewer immediately below the lateral. At the plant the 12-in. pipe discharges through a 10-in. valve into a covered flume 3 ft. 6 ins. wide equipped at its inlet end with a coarse bar screen for the removal of sticks and other large objects. The flume leads to the suction well of a 6-in. centrifugal pump which lifts the sewage about 14 ft. 6 ins. to a raw sewage flume, placed at such an elevation that the sewage can flow thence by gravity through the treatment plant. From this flume the sewage flows on to a horizontal flat plate screen with closely spaced holes ¼ in. in diameter, through which it falls into a hopper-bottomed grit chamber. The raw sewage flumes, fine screens and grit chambers are in duplicate, only one-half being used at a time. The screened sewage overflows from the grit chamber into the screened sewage flume, passes over a 3-ft. weir, is treated with a suspension of lime, and then passes through a 12-in. pipe to the electrolytic cell. From the cell the sewage flows through an open observation flume connected to the treated sewage flume, and thence over concrete riffles into the sedimentation basins. The two basins are connected in series, and have a combined capacity, to the elevation of the outlet weir of 88,740 gals., giving when clean a detention period of about 2⅛ hours on a flow of 1,000,000 gals. per 24 hours. A 4-in. sludge pipe is provided from each basin to permit of drawing the sludge onto two small sludge drying beds immediately east of the sedimentation basins.

The entire plant, with the exception of treated sewage flume, sedimentation basins and sludge beds, is neatly housed in a sheet iron building, 48 ft. 3 ins. long and 35 ft. 6 ins. wide. The difference in elevation between the fine screens and the overflow weir from the sedimentation basin is 5 ft.

By-pass arrangements permit of running screened or screened and lime-treated sewage from the weir box direct to the river, or of running treated sewage from the treated sewage flume to the river without passing through the sedimentation basins. An overflow pipe in the screened sewage flume diverts any excess over the capacity of the plant, returning it to the pump well. The low concrete dam in the main sewer permits the latter to take the entire flow when the pump is not operated or excess flow in time of storm.

Electrolytic Apparatus

The electrolytic apparatus is enclosed in a horizontal wooden tank, 27 ft. 3 ins. long, 3 ft. wide and 2 ft. 9 ins. high (outside dimensions), reinforced with steel plates and mounted on supports 18 ins. high. The 2-in. wrought iron vent pipes are carried up from the top of the tank for the removal of any excess gaseous products of electrolysis. A series of blow-out valves are provided along the bottom of the tank.

This tank contains 22 banks of plates, arranged in two layers of 11 banks each. Each bank of electrodes consists of 48 rectangular steel plates 16 ins. long, 10 ins. high and 3/16 in. thick, placed parallel to the sides of the tank, and spaced ⅜ in. apart. The plates are so connected that alternate plates have the same polarity, giving 24 pairs of plates connected in multiple in bank, the 22 banks being connected in series. Spaces between the banks and the sides of the tank are closed, compelling the sewage to flow through the ⅜-in. spaces between the plates. In each space between the plates two straight paddles of Bakelite are revolved, being attached to shafts passing through holes punched in the plates to receive them. The paddles are driven at a speed of 20 revolutions per minute by a 3-h.p. motor, the power being transmitted to the paddle shafts through suitable reduction gearing. The total number of paddles in this plant is 2,068.

At the normal rating of the plant, i.e., 1,000,000 gals. daily, the time of passage through the electrolytic cell is approximately 70 seconds, of which 17.4 seconds represent the time of contact with the electrodes, the remainder of the time being occupied in passing through dead space between successive electrodes. During contact the sewage travels in streams ⅜ in. thick for a distance of 14 ft. 8 ins. at a theoretical velocity of 0.84 ft. per second.

Lime Apparatus

Provision is made for using either lump or hydrated lime. When the former is used the lumps are broken by hand on a 3-in. grid placed over a crusher, which discharges into an elevator boot. When hydrated lime is used a spout delivers it directly into the elevator boot. The elevator discharges into an overhead hopper from which it is fed dry by adjustable feeding devices to the solution tanks.

The solution tanks are two in number, each 7 ft. in diameter and 3 ft. deep, each with an independent feeding device and agitator. Only one tank is used at a time.

The feeding device consists of a trough with a double worm feed actuated by a ratchet and pawls, which in turn are driven by a reciprocating link attached to an eccentric. The rate of feeding lime to the solution tank may be adjusted within certain limits by changing the throw of the eccentric and by varying the number of teeth engaged on the ratchet by changing the position of the pawl arm.

Either city water or plant effluent can be used in the solution tanks; when the effluent is used it is pumped by a motor-driven 1-in. centrifugal pump. In either case, the water enters the tank tangentially near the bottom to help the agitation and the lime suspension or milk of lime is drawn from the top of the tank. Agitation is by means of a two-bladed 10-in. fan placed at the bottom of the tank and operated at 900 r.p.m. by the 1-h.p. motor, which also drives the feeding device. The circulation is downward at the centre and upward at the sides.

Suitable piping delivers the lime suspension into either the spillway of the weir or the observation flume as desired.

Electric Motors

The following is the list of electric motors installed:—

For initial pumpage of raw sewage	1—7½ h.p. motor.
For lime treatment—	
Lime crusher	1—5 h.p. motor.
Effluent pumps	2—1 h.p. motor.
Feeding and agitation	2—1 h.p. motor.
For electrolytic cell—	
Paddles	1—3 h.p. motor.
Electrolysis	1—5 k.w. motor generator set.
For handling grit and sludge—	
Grit pump	1—2 h.p. motor.
Sludge pump	1—1 h.p. motor.

Of the four 1-h.p. motors listed under lime treatment only two would be in service at a time.

Description of the Process

The process is essentially one of fine screening, followed by lime precipitation, agitation, electrolysis and sedimentation.

The screening through ¼-in circular openings removes from the crude sewage solid particles of larger size than these openings.

The addition of the lime is claimed by the owner of the electrolytic process to be essential to that phase of the treatment of the sewage, but it should be borne in mind that chemical precipitation of sewage is one of the oldest processes known to the art and produces a very considerable removal of suspended solids.

The electrolytic action liberates nascent oxygen and hydrogen by the passage of the electric current through sewage rendered alkaline by the addition of lime. The agitation, in addition to its well-known effect in inducing precipitation, brings the sewage into intimate contact with the products of electrolysis. Chemical reaction is thereby stimulated while the gases are still in the nascent state and before they have an opportunity to escape. The paddles undoubtedly serve also to mechanically clear the plates and prevent polarization.

Positive Alkalinity

In normal operation the lime suspension is added to the sewage immediately before entering the electrolytic cell in order to insure positive alkalinity, a condition considered necessary for electrolysis without attack of the electrodes. There is a gradual deposit of calcium carbonate on the plates, which it is claimed can be remedied by temporarily shifting the point of applicaton of the lime to the outlet flume leading from the electrolytic cell. The sewage under such conditions is said to rapidly remove the coating from the plates, permitting normal operation to be resumed in 15 or 20 minutes. A heavy deposit on the plates is indicated by a marked increase in the power required to drive the paddles. No considerable increase was noted during the period of the test.

Some polarization of the plates occurs from time to time, but this is overcome by a reversal of the polarity, which quickly decreases the necessary voltage and increases the current.

For satisfactory operation it is said that the cell effluent should contain not less than 30 parts per million of excess alkalinity. During the period of the test this content was always exceeded.

As the sewage reaches the observation flume after passage through the electrolytic cell it contains the lime and the suspended solids. The subsequent sedimentation is to permit the deposition of these materials so as to clarify the effluent and separate the sludge for treatment.

Condition of Test

The plant had been closed since about October 15th, and intermittent operation was again resumed on December 2nd, only two days prior to starting the 8-hour test.

During the test the plant was operated by the company in order that there might be no division of authority and to controvert possible criticism regarding inefficient operation. The department's representatives observed the operation of the plant, made tests on power consumption, quantity of lime used, flow of sewage, and took samples of the sewage, etc.

Prior to undertaking the test all by-pass connections were closed and sealed, electric meters and water meters were read, and various measurements were made of the dimensions of the units.

During the 8-hour test electric and weir readings were taken at intervals of 15 minutes and at intervals of 30 minutes during the 24-hour test. Samples of the sewage, proportional to the flow, were collected every 30 minutes during the 8-hour test and every hour during the 24-hour test. These were mixed to form composites for chemical analysis for each test run. Settleability and alkalinity samples were collected every four hours, and putrescibility, dissolved oxygen and bacteriological samples were collected every 8 hours. Lime samples were collected at irregular intervals, averaging probably two hours, and thoroughly mixed, forming a single sample for analysis.

The Standard Methods of Analysis of the American Public Health Association were followed at the laboratory.

The flow of sewage was determined by weir readings taken every 30 minutes during the tests and varied from a minimum of 309,000 gals., which occurred at 2.30 a.m., to a maximum of 816,000 gals., which occurred at 11.30 a.m. The average flow during the 24-hour test was at the rate of 460,000 gals. per day, or slightly less than one-half the rated capacity of the plant.

During the 8-hour test the polarity of the electrolytic cell was changed at 3.23 p.m. in order to decrease the effects of polarization. Immediately after such change the voltage was found to be 40 and the amperage 55. During the 24-hour test a similar change was made on several occasions, but the exact hours were not noted.

At 4.20 on December 6th a portable voltmeter was applied to the various electrodes to determine whether the total voltage at that time was evenly distributed throughout the electrolytic cell. The results at the outlet end were as follows:—

Upper bank..	2.8	2.7	2.85	2.7	2.75	2.9	2.95	2.9	3.1	3.0	3.75
Lower bank..	3.0	2.7	2.55	2.65	3.0	2.9	2.8	2.75	3.4	2.8	3.45

Immediately after the completion of the test the switchboard ammeter was compared with a portable millivoltmeter with external shunt. The two were found to agree within 2 or 3 per cent.

Summary of Results of Tests

The following is a summary of the results of the tests:—

Power Consumption.	8-hr. test.	24-hr. test.
Lights and electric heaters..	11 k.w. hrs.	47 k.w. hrs.
Pump motor	30 k.w. hrs.	90 k.w. hrs.
All other power	50 k.w. hrs.	130 k.w. hrs.
Total	91 k.w. hrs.	267 k.w. hrs.
Total water consumption*..	66 cu. ft.	166 cu. ft.
Quantity of lime.....	....	1,712 lbs.
CaO content	....	61.52%
Average voltage for electrolysis	56.3	57.5
Average current for electrolysis, amperes	37.8	33.8
Average wattage for electrolysis	2,125	1,944
Average wattage for paddles	1,388	1,355
Sewage flow in gals. per 24 hrs.	482,700	460,000
Average sewage flow in gals. per hour	20,110	19,190
Electrolytic hydrogen liberated in grams per hour..	31.04	27.82
Electrolytic oxygen liberated in grams per hour.....	247.73	222.03
Ratio of electrolytic hydrogen to sewage by weight....	0.4 p.p.m.	0.4 p.p.m.
Ratio of electrolytic oxygen to sewage by weight...	3.2 p.p.m.	3.0 p.p.m.

Bacteriological Results

Figures represent Bacteria per C.C.

8-Hour Test.

	Time	Raw Sewage	Screened Sewage	Cell Effluent	Basin Effluent
Total bacteria.	2.30 p.m.	800,000	200,000	38,000	2,000
B. Coli	2.30 p.m.	36,000	24,000	0	0

24-Hour Test.

December 6th—					
Total bacteria.	8.00 a.m.	920,000	680,000	24,000	65
B. Coli	8.00 a.m.	100,000	120,000	0	0
Total bacteria.	4.00 p.m.	240,000	216,000	2,500	1,500
B. Coli	4.00 p.m.	12,000	50,000	0	0
Total bacteria.	12 midnight	48,000	16,000	190,000	18,000
B. Coli	12 midnight	15,000	18,000	0	0
December 7th—					
Total bacteria.	8.00 a.m.	1,200,000	1,800,000	24,000	30,000
B. Coli	8.00 a.m.	45,000	30,000	0	0

*Includes toilet, lavatory and the stuffing boxes of the centrifugal pump.

Physical and Chemical Results

8-Hour Test.

	Time	Screened Sewage	Basin Effluent
Total alkalinity	12.15 p.m.	106	193
Total alkalinity	4.00 p.m.	103	326
24-Hour Test.			
December 6th—			
Total alkalinity	8.00 a.m.	98	380
Total alkalinity	12.00 m.	89	276
Total alkalinity	4.00 p.m.	88	252
Total alkalinity	8.00 p.m.	98	282
December 7th—			
Total alkalinity	12.00 midnight	85	288
Total alkalinity	4.00 a.m.	86	341

Screenings Removed—(24-Hr. Test)

Bar screen	117 lbs.
Plate screen	379 lbs.

Results Expressed in Parts per Million—(24-Hr. Test)

	Raw Sewage	Screened Sewage	Cell Effluent	Basin Effluent
Total solids	217	248	608	640
Volatile solids	114	140	196	94
Fixed solids	103	108	412	546
Suspended solids	74	69	215	26
Nitrogen as—				
Organic	34.5	34.2	21.5	21.6
Free ammonia	11.3	11.5	9.2	9.3
Nitrites	0.045	0.05	0.06	0.06
Nitrates	0.46	0.45	0.93	0.90
Oxygen consumed	53	52	44	44

Raw sewage samples were collected from the discharge pipe of the pump after sewage had passed the bar screen. Screened sewage samples were collected after the sewage had passed the bar screen, the pump, the plate screen and the grit chamber. The samples of the cell effluent were taken from the observation flume. This sewage had passed the bar screen, the pump, the plate screen, the grit chamber and the electrolytic cell, and had also received the lime treatment.

Dissolved Oxygen

	Time	Temperature Degrees C.	Content P.P.M.	Saturation Pct.
Cell influent	10 a.m.	12.0	3.7	34
Cell effluent	10 a.m.	11.0	5.2	47
Cell influent	6 p.m.	12.0	6.8	63
Cell effluent	6 p.m.	11.0	7.0	63
Cell influent	2 a.m.	12.5	6.7	62
Cell effluent	2 a.m.	12.5	8.3	77

Putrescibility

Using Methylene Blue at 20 Degrees C.

8-Hour Test.

	Raw Sewage Days	Screened Sewage Days	Cell Effluent Days	Basin Effluent Days
1.45 p.m.	1	1½	4½	9½
24-Hour Test.				
December 6th—				
9.00 a.m.	1	1	14	14
3.00 p.m.	1½	1½	14	12
11.00 p.m.	1½	1½	14	14
December 7th—				
7.00 a.m.	1½	1½	14	14

Putrescibility of Sludge from Resettling Basins

	100% sludge	75% sludge, 25% river water	50% sludge, 50% river water	25% sludge, 75% river water	100% river water
Standard quantity methylene blue solution	3 hrs.	3 hrs.	3 hrs.	3 hrs.	14 days
Three times standard quantity methylene blue solution	3 days	14 days	1 day	3 days	14 days

In the above table the entries signify the period during which the samples retained a blue color excepting in cases where the entry reads 14 days, which signifies that the color was still present when the samples were thrown away at the end of the 14-day period.

It was feared the bleaching properties of the lime would have a marked effect on the methylene blue solution added to samples of sludge mixed with varying proportions of the river water. Accordingly, the standard quantity of methylene blue solution was added to one set of samples and three times this standard quantity to the check set, including the control samples. It will be noted that the samples of 100% river water were stable for two weeks in both cases, but in the other samples, containing varying proportions of sludge and river water, the lime apparently had a perceptible effect upon the methylene blue. The samples containing the greater proportion of methylene blue retained the color for longer periods, although the period of retention of color was not proportional to the percentage of river water, tending to throw some doubt upon the accuracy of this determination.

The appearance of the raw sewage was typical of fresh dilute sanitary sewage from an American municipality except at times when brewery wastes are present.

The effluent from the electrolytic cell had a brownish cast, contained a flocculent precipitate, and evidenced tendency to form a floating froth in the observation flume and inlet end of the settling basin. The flocculent precipitate settled rapidly, leaving a clear, greenish-tinged supernatent liquid, excepting when large volumes of brewery wastes were passing through the plant, when the effluent from the basin was clear amber color and contained some suspended matter.

There was no opportunity during the test to determine the feasibility of drying sludge from the settling basin upon the sand beds.

At the end of the 24-hour test the cover on the effluent end of the electrolytic cell was removed and the electrolyte drawn down a short distance below the top of the plates. After removal of the coating these plates, as far as could be seen, were bright and in good condition. The coating, which was removed easily by rubbing with the fingers, was found on analysis to contain 1.73% of iron.

There was no evidence during the test that under operating conditions there is a rapid deterioration of the plates to form a chemical coagulant, which was purposely intended in the early processes for the electric treatment of sewage.

Life of Electrolytic Cell

The company states that the cell under test at Easton had not received any repairs during the summer, and, in fact, the cell cover had not been removed prior to the conclusion of the 24-hour test when it was opened at request of the department representatives in order to observe the condition of the plates.

Records of electric current consumed during the past summer (May to October, inclusive) were obtained from the monthly statements of the local electric company. It was found that the current consumed by the pump would have been sufficient for approximately 18 days' continuous operation and current recorded by the meter supplying circuits for the lime-feeding and mixing devices, the solution pump, electrolytic cell and revolving paddles would have been sufficient for approximately 16 days' continuous operation. These periods are obtained by using the current consumption during the 24-hour test as a basis. The higher figure for the pump is probably due to the fact that the flow of sewage was greater on some days than during the 24-hour test, while the current required for the lime-feed and the cell did not vary uniformly with the flow of sewage.

The company states that the cell remained filled with sewage during periods when it was not operated.

Freedom from Nuisance

During the department's test the entire apparatus was free from objectionable odors. Inquiry was made at houses in the vicinity and it was found that the residents quite generally had no cause for complaint.

There is little reason to anticipate nuisance conditions from the screens, cell or settling basins when handling fresh sewage for there would normally be dissolved oxygen present throughout the process. Freedom from nuisance, however, cannot be predicted with any degree of certainty in a large municipal plant which must necessarily contain sludge beds or sludge presses for dewatering the sludge. In fact, it is altogether probable that disposal of the sludge would at times be attended by offensive odors.

Difficult to Predict Costs

It is difficult to predict, with a satisfactory degree of accuracy, the cost of operating a large unit by comparison with data collected through operation of a single small unit. However, in the absence of complete information reliance must be placed upon such data as are available and reasonable factors applied to meet expected conditions in the larger plant. The following figures regarding cost of operating the plant at Easton are therefore given as a rough indication of what might be expected, but apply more particularly to a plant of a similar size operating under the same conditions—namely, pumping of sewage and the addition of lime at a rate stated by the owner of the patent as being greatly in excess of that necessary to secure satisfactory results:—

Cost of Operation

Without Pumpage—	
Hydrated lime, 1,712 lbs. at $6.75 per ton	$ 5.78
Water for mixing lime, 20 cu. ft. at $0.003 per cu. ft.	.06
Electric power, 130.6 k.w.h. at $0.0226	2.95
Electric lights, 6¼ k.w.h. at $0.0805	.50
Heating	1.25
Labor and superintendence	15.00
Electrode renewals, company's estimate	1.00
Maintenance and repair	1.50
Total	$28.04
Add for Pumpage—	
Electric power, 88.3 k.w.h. at $0.0226	2.00
Water, 120 cu. ft. at $0.003 per cu. ft.	.36
Total	$30.40
Equivalent cost per 1,000,000 gals.	66.00

These figures are on the basis of pumping and treating 460,600 gals. excluding allowance for interest and sinking fund charges and cost of sludge pumping, treatment and disposal. The costs of hydrated lime, water and electric current are those which the department understands obtain at Easton. The figure for labor and superintendence is based upon employment of a superintendent at $1,650 a year who should be able to make necessary bacteriological and chemical tests and who is familiar with the theory of operation of the

(Continued on page 395.)

GOVERNMENT CONTROL OF G.T.R.

THE Grand Trunk Railway System of Canada, with all its lines in and out of the Dominion, including the Grand Trunk Pacific, is to pass into the possession and control of the Dominion Government. The bargain has been made with the government by Sir Alfred Smithers, representing the stockholders of the Grand Trunk. It will have to be ratified by Parliament and by the stockholders of the Grand Trunk.

The stock of the company is to be acquired by the government. The payment will not be in cash, but by an exchange of securities. The holders of the preferred and common stock will transfer their shares to the government, and will receive in exchange therefor shares which will have no voting power, but will earn four per cent. guaranteed by the government. As the preferred and common shares of the company are now considerably below par, their value is to be determined by a board of arbitration and the agreement provides for the appointment of such a board.

The debentures will be assumed by the government. They amount to £31,926,125. The guaranteed stock, amounting to £12,500,000, will be treated as debenture stock, and the payment of the 4 per cent. dividend will be guaranteed by the government.

The holders of debentures and guaranteed stock are to surrender all voting powers.

The other stock of the company falls into four classes, namely, first preference, second preference, third preference and common; the total par value of these four stocks is £37,073,492.

As soon as the bargain has been ratified, the road will be turned over to a committee of management. Two members of the committee will be named by the government and two by the company, and the four will select a fifth member. This committee will operate the road during the arbitration, and will operate it in close connection with the Canadian National Railway System. After the arbitration has been completed and the stock has been transferred to the government, the committee of management will be discharged and the Grand Trunk lines will become a part of the Canadian National Railway System.

In estimating the value of the stock the arbitrators are to refer to the fixed charges and other liabilities of the Grand Trunk and will take into consideration all the liabilities of the Grand Trunk on account of the Grand Trunk Pacific.

Hon. Arthur Meighen, Minister of the Interior, has introduced into Parliament a resolution ratifying the agreement with the G.T.R. It will be debated at length during the present session.

PROPOSED SCHEDULE OF CIVIC SALARIES AT BALTIMORE

THE Baltimore chapter of the American Association of Engineers presented to the Board of Estimates of the city of Baltimore, under date of September 27th, a report of the compensation committee of that chapter on salaries of engineer employees of the city, with the request that the board analyze the situation and take such action as seems advisable.

The schedule recommended covers more than 60 grades of engineer employees of the city. It recommends an increase for the chief engineer of at least $2,500 to bring his salary up to a minimum of $10,000 per annum, with a maximum of $15,000. Some of the other recommendations are tabulated below:—

Present Title	Present Annual Salary	Annual Salary Recommended by Committee Minimum	Maximum
Highways Engineer, Water Engineer, Harbor Engineer, Chief Engineer Paving Commission and Inspector of Buildings	$4,000	$5,000	$7,500
Division Engineer of Sewers	3,300	3,600	5,000
Principal Assistant Engineer Water Department	3,000	3,600	5,000
Mechanical Engineer Water Department	2,700	3,600	5,000
Assistant Engineer Water Department	2,200	2,700	3,300
Assistant Engineer of Bridges and Improvements Highway Dept.	2,000	2,700	3,300
Designing Engineer Water Department	1,800	2,700	3,300
Assistant Engineer, Grade AA, Water Department	.....	2,400	3,000
Office Engineer Paving Commission	2,000	2,400	3,000
Field Engineer Highways Department	1,500	2,400	3,000
Draftsmen all Departments	1,500 max.	1,500	2,100
Instrumentmen all Departments.	1,200	1,500	2,100
Rodmen all Departments	1,020	1,200	1,500
Tracers all Departments	840 max.	1,080	1,200
Chainmen all Departments	900 max.	1,080	1,200

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ASSOCIATION OF C. B. & C. I. CONSTITUTION

THERE should be no delay in adopting the constitution that has been drawn up for the Association of Canadian Building and Construction Industries by its president, J. P. Anglin, of Montreal. The association has been badly handicapped in its work this year by the lack of such an instrument. Both Mr. Clarson, the former general secretary, and Mr. Reilly, the present acting general secretary, have been placed in the undesirable position of "passing the hat" instead of being able to solicit membership upon a clean-cut basis in a definite organization.

The Association of Canadian Building and Construction Industries began well at the splendid general conference held last November in Ottawa, but since then it has been largely a mythical and shadowy form, lacking definiteness and concrete shape. The constitution which Mr. Anglin proposes, if formally adopted by the members of the national council, to whom the delegates of the last convention gave the right to prepare and adopt such a constitution, the whole status of the association will be materially and beneficially changed.

By the adoption of this constitution, the association will become a living entity. There will be a definite *modus operandi* and fees will be collected upon a business-like basis. The relations of the association to local bodies will be clearly defined, and through the large representation of local bodies in the membership of both the association at large and of the national council, the various builders' exchanges through the country will, to a large extent, govern the affairs of the national association. In fact, with the strengthening and growth of the local associations that will result from the co-operation of the national association, the representation of local associations will so grow that the national association will largely become a national parliament of representatives of local associations.

These representatives, who will in the main be representatives of a large number of comparatively small firms throughout the country, will be aided in their deliberations, and their actions will be given additional weight and prestige, by the presence in these national parliaments of the direct members, who will in the main be representatives of the big business interests of the country.

ARBITRATION vs. INVESTIGATION

AN interesting article in the constitution that is being considered by the national council of the Association of Canadian Building and Construction Industries, but one which is not likely to prove of very tangible benefit to members of the association, is the article providing that the executive committee be empowered to appoint arbitrators to hear and decide controversies, disputes or misunderstandings relating to any commercial matters or practice as between members of the association, which may be voluntarily submitted by the parties in dispute.

We venture to predict that the executive committee will not be worked overtime with the appointment of such boards of arbitration. A board appointed in such a manner would be a tribunal or investigating committee, but not a board of arbitration. The members who make use of this clause will be practically referring their disputes to the executive committee, or at least, practically speaking, to a sub-committee whom the executive committee may appoint to examine into and settle the dispute.

There is only one way in which a real board of arbitration can be formed, and that is the generally recognized method of having one party to the dispute appoint one member and the other party to the dispute appoint the second member, and then to have those two members select a third.

It is possible, however, that the arbitrations which the framers of this constitution had in mind, were not so much industrial or financial disputes as trade customs or practices. Just how far the executive committee or national council of the association should go, either directly or through appointed committees, in legislating trade practices, is a debatable point and one which will no doubt be the subject of much discussion in years to come.

There is no question but that the association could be of material benefit to the building and construction industry as a whole by enforcing certain desirable customs and by eliminating a number of undesirable practices; however, activities along these lines are very likely to be challenged by individual members, and might be misunderstood by the public as savoring too much of a "gentlemen's agreement" or "contracting ring." The arbitration article in the association's constitution will prove to be either a dead letter or else somewhat of a "joker," pregnant with possibilities.

C. M. I. COMMENT ON CLASSIFICATION

"COMMENT on the new Civil Service classification and schedule of compensation has already appeared in several recent issues of the 'Bulletin,'" says the October issue of the "Canadian Mining Institute's Bulletin." "The proposals embody the recommendations made to the government by Arthur Young & Co., of Chicago, Toronto and New York, and they have called forth serious objections from many of the engineers in the civil service.

"The classification proposed is so unscientific and cumbrous that it is an almost impossible task to make a comparative analysis of the salary schedule as it applies to technical men in the different government departments. So far as is possible, however, such an analysis has now been made by Arthur S. Tuttle, chairman of the U.S. Engineering Council's committee on classification and compensation of engineers.

"Since this committee has made a special study of the subject, Mr. Tuttle's report carries weight. It raises many of the same criticisms which have already been voiced by individual engineers."

OPERATING RESULTS OF "DIRECT OXIDATION"

(Continued from page 393)

process and upon employment of an operator on each 8-hour shift at a salary of $1,200 a year.

If we assume that the plant could be operated continuously at a normal rating (1,000,000 gals. a day) the unit costs would be materially reduced and would probably be approximately as follows:—

Without Pumpage—	
Hydrated lime, 3,720 lbs. at $6.75 a ton	$12.56
Water, 20 cu. ft. at $0.003 per cu. ft.	.06
Electric power, 185.5 k.w.h. at $0.0226	4.19
Electric lights, 6¼ k.w.h. at $0.0805	.50
Heating	1.25
Labor and superintendence	15.00
Electrode renewals	1.00
Maintenance and repairs	1.50
	$36.06
Add for Pumpage—	
Electric power, 117.7 k.w.h. at $0.0226	$ 2.66
Water, 120 cu. ft. at $0.003	.36
Total	$39.08

These figures are exclusive of allowance for interest and sinking fund charges and cost of sludge disposal. It will be noted that the lime has been increased proportionately to the flow as this quantity was added during the test. Should it later appear that the quantity of lime can be reduced without deterioration of the effluent there would be a corresponding reduction in cost of treatment. It is probable that the cost of sludge, pumping, treatment and disposal will be in the neighborhood of $7.50 per 1,000,000 gals.

Conclusions of Engineering Division

Consideration of the performance of the plant as operated by the owners and as observed by the members of the Engineering Division of the department on December 4 and 6, 1918, lead to the following conclusions:—

1. The combined action upon the sewage of the fine screen, lime treatment and the electrolytic cell render the sewage in such a condition that after sedimentation in properly designed tanks, the effluent can be discharged into a stream, affording a reasonable dilution of relatively clean water, without danger of creating a nuisance. It is, of course, assumed that the effluent will be discharged through properly designed outlet so as to cause dispersion in the stream.

2. The fine screen, lime treatment and electrolytic cell have a destructive action on bacteria of the colon group. If, however, the use of the receiving body of water demands a high degree of bacterial removal in sewage effluents discharged therein, it would be on the side of safety to provide for disinfection of the cell effluent.

3. Assuming fresh domestic sewage, proper design, operation and maintenance of the various devices, the treatment of sewage by the above described processes should be free from objectionable odors, with the possible exception of the removal and disposal of the screenings and the sludge from the final settling basins.

4. Similar screenings are being successfully disposed of elsewhere by incineration or burial and the sludge from the final settling basins should be susceptible of dewatering by presses such as are used in sewage treatment works, including the lime precipitation method.

5. The process should be extended by installation of some adequate method for treatment of sludge removed from the settling basins as discharge of this sludge with the cell effluent is not permissible.

6. The cost of installation of a sewage treatment works, including the above processes should not be excessive, but the cost of operation would appear to be higher than for other methods of sewage treatment in general use to produe an equal quantity of effluent.

Each proposed installation should be examined by com-

(Concluded on page 396)

PERSONALS

J. M. DIVEN, secretary of the American Water Works Association, who is planning the details of the next annual convention, which will be held in Montreal, Que., has resigned as superintendent of the bureau of water of Troy, N.Y., and will devote his entire time hereafter to the affairs of the association. Mr. Diven's headquarters will be in New York City, the association having secured rooms at 153 West 71st St. Mr. Diven's connection with the water works industry has been of long standing. In November, 1873, he was appointed as an assistant in the office of the Elmira Water Works Co., in Elmira, N.Y., and two years later became secretary-treasurer of the company. At first he was in charge of the office, but later he gradually assumed the outside work, and in 1886 he was appointed superintendent of the company. In January, 1905, Mr. Diven resigned at Elmira in order to go to Charleston, S.C., as superintendent of the Charleston Light & Water Co., which position he relinquished in 1912, when he was appointed superintendent at Troy. Mr. Diven was first appointed secretary of the American Water Works Association in 1889, and he served in that capacity until 1891, when he was elected president. The following year he became secretary-treasurer, but later those two offices were separated and since 1902 he has been secretary of the association.

D. W. MUNN, of Montreal, has been appointed professor of civil engineering at the Royal Military College, Kingston, Ont.

LEONARD DUNAWAY, who has been in the British navy for the past four years, has been appointed superintendent of the Vermilion, Alta., power plant.

M. J. BUTLER, managing director of Armstrong & Whitworth of Canada, Ltd., of Montreal, has resigned and is now living in Oakville, Ont. Mr. Butler was deputy minister and chief engineer of the Department of Railways and Canals from 1905 to 1910, when he resigned to become second vice-president and general manager of the Dominion Iron & Steel Co. and the Dominion Coal Co. He left the Dominion companies in 1912 in order to organize a Canadian branch for the well-known English firm, Sir W. G. Armstrong, Whitworth & Co., Ltd. Mr. Butler is a Companion of the Order of St. Michael and St. George, and is also a doctor of laws. He was called to the Illinois bar in 1897, nineteen years after he commenced practice as an engineer and Dominion Land Surveyor.

OBITUARY

FRANK J. LYMAN, managing director of the Lyman Tube & Supply Co., Ltd., Montreal, died suddenly two weeks ago at the age of 42. He was the founder of the business, which was the successor to the railway department of John Millen & Son, Ltd., Montreal, which department he managed for 10 years prior to the establishment of the Lyman Tube & Supply Co., Ltd.

OPERATING RESULTS OF "DIRECT OXIDATION"

(Continued from page 395)

parison with other methods of sewage treatment to determine if savings in installation cost would be sufficient to counterbalance the increased maintenance and operation charges.

If it should be determined that the proportion of lime could be materially reduced without deterioration in the quality of effluent there would be a proportionate reduction in operating costs.

7. To permit continuous operation of a works including these processes, electrolytic cells and other equipment must be in duplicate. It is undoubtedly necessary to replace plates in the electrolytic cell from time to time and accordingly a type of cell should be adopted which admits of such renewals in place and at a minimum cost for labor.

8. The short observations of the combination of fine screening, lime treatment, electrolytic cells and final settlement appear to justify an extended test by this department should the opportunity be offered. Such tests should include study of results secured with lime additions reduced to the proportion the owner of the patent claims as the actual needs of the process and should also include study of various methods of treatment and disposal of the sludge from the resettling basins.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand or proposed, contracts awarded, changes in staffs, etc.

ADDITIONAL TENDERS PENDING

Not Including Those Reported in This Issue

Further information may be had from the issues of *The Canadian Engineer*, to which reference is made.

PLACE OF WORK	TENDERS CLOSE	ISSUE OF	PAGE
Belleville, Ont., excavation and building foundation walls	Oct. 17.	Oct. 9.	48
Hartney, Man., wooden pile bridge	Oct. 17.	Sept. 25.	45
Port Maitland, Ont., reconstruction of pier	Oct. 20.	Oct. 9.	54
Rimouski, Que., monument	Oct. 30.	Sept. 25.	52
Shellmouth, Man., bridge floor	Oct. 21.	Oct. 9.	45
Toronto, Ont., annual supplies	Oct. 28.	Oct. 9.	46

BRIDGES, ROADS AND STREETS

Barrie, Ont.—Sidewalks may be constructed on Victoria St., between Sanford and Innisfil Streets, on the south side of Sophia St., on the west side of Bayfield St., and on the north side of Ross St., from Small St. to Kidd's Creek.

Barrie, Ont.—The town council instructed K. S. Macdonell, town engineer, to secure estimates on a pavement for Dunlop and Elizabeth Streets.

Batiscan, Que.—The provincial government has decided to erect a steel bridge over the Batiscan river.

Bedford Tp., Que.—The township council decided to carry out a programme of road improvement. Application will be made to the Provincial Road Department for $20,000 under the Good Roads Act, and the roads will be built as early as possible next year.

Calgary, Alta.—City council decided to have Tenth Ave., from Eighth St. W. to Fourteenth St. W., graded, at a cost of $2,366. City clerk, J. M. Miller.

Chatham, Ont.—Tenders will be received by W. M. Abraham, R.R. No. 1, Chatham, Ont., up till noon on Saturday, October 18, for the construction of about 18,000 square feet of sidewalk on Grand Ave. and Taylor Ave., near Chatham. Plans and specifications may be seen at the office of W. G. McGeorge, C.E., Chatham.

Dundas, Ont.—Ratepayers will vote on a by-law to provide $3,500 for rebuilding Head St. bridge. Engineer, J. W. Tyrrell, Hamilton.

Hamilton, Ont.—The city council intends to construct a pipe sewer on Bay St., from Macaulay St. to Burlington St. S. H. Kent, city clerk.

L'Assomption, Que.—Tenders will be received up to 10 o'clock a.m. of October 20th, 1919, by Jos. E. Duhamel, secretary-treasurer, L'Assomption, Que., for the erection of a bridge. One price must be for the superstructure in steel and another price for all the other work in constructing the bridge. For all further particulars, address the secretary-treasurer.

Lindsay, Ont.—Town council instructed the board of works to construct several granolithic walks. Clerk, Duncan Ray.

London, Ont.—A by-law will be submitted to the ratepayers in January, authorizing an expenditure of $50,000 for a new bridge on Ridout St.

London, Ont.—Tenders, addressed to the "Chairman and Members, No. 2 Committee," will be received at the office of the city clerk up to 3 p.m. on Monday, October 27th, 1919, for the supply of one 1,200 U.S. gallon capacity motor-driven street flusher, complete. Specifications, etc., may be obtained at the office of H. A. Brazier, city engineer.

London, Ont.—The construction of a new pavement on King St., between Wellington and Richmond Sts., is to be commenced at once. City clerk, S. Baker.

New Westminster, B.C.—The provincial department of railways has decided to construct a footbridge sidewalk as an addition to the railway bridge which spans the Fraser river here. Estimated cost about $13,000 or $14,000.

Norwood, Ont.—It is reported that the Provincial Highways Department, in order to test the qualities of the rock from the Belmont township quarries for road-building, will construct a piece of road between Havelock and Trent River, a distance of about four miles.

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When the roof on the foundry building shown above was completed we gave the owners a Surety Bond *guaranteeing* their roof to be free from maintenance expense for *20 years*.

In this case the Surety Bond was hardly necessary, for the Thos. Davidson Mfg. Company, Ltd. knew from experience what service to expect, as the following paragraph from their letter to us shows:

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Not only are Barrett Specification Roofs "in every way satisfactory," but they cost less per-year-of-service than any other type of permanent roof, and they take the base rate of fire insurance.

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So sure are we of the service Barrett Specification Roofs will give *under the most severe conditions*, that we are prepared to *guarantee them for 20 years*, in all towns of 25,000 or over, and in smaller places where our Inspection Service is available provided they are 50 squares or more in area. The guaranty costs you nothing. We merely require that our Specification dated May 1, 1916, shall be strictly followed and that we have an opportunity to send inspectors to watch the job during construction. The guaranty is a Surety Bond issued by a well-known fidelity and guaranty company.

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MONTREAL TORONTO WINNIPEG VANCOUVER
ST. JOHN, N.B. HALIFAX, N.S. SYDNEY, N.S.

Shipton Tp., Que.—Township council decided to either repair or rebuild the bridge in No. 75 district.

Simcoe County, Ont.—The Simcoe County Roads Committee let contract to R. Curran and Co., at $12,500, for the paving of Atherley Rd., from the G.T.R. track to Moffatt St., a distance of half a mile. The contract calls for a concrete road, 20 ft. wide, with storm sewers and ditches.

Smith's Falls, Ont.—The Provincial Highways Department has approved of the designation made by the Lanark county council of a county provincial highway, estimated to cost over $700,000.

St. Clements, B.C.—Tenders addressed to Duncan C. Scott, deputy superintendent-general on Indian affairs, Department of Indian Affairs, Ottawa, and endorsed "Tenders for the construction of a wooden bridge over the Brokenhead river, river lot 6, Brokenhead Indian Reserve, municipality of St. Clements, B.C.," will be received up to noon, November 19th, 1919. Plans and specifications may be seen at the post office at Selkirk, Man., and at the office of Inspector Bunn, Winnipeg, Man., also upon application to the Department of Indian Affairs, Ottawa, Ont.

St. John, N.B.—City council is considering repairs to City Rd. sidewalk, between Gilbert's Lane and Wall St., at an estimated cost of $7,000. City engineer, G. N. Hatfield.

St. John, N.B.—A parkway through King St. E. is proposed by the civic authorities. A sketch of the street shows a parkway 20 ft. in width extending through the centre, with paved roadways 30 ft. in width on either side, and protected by curbing.

St. Louis de Gonzague, Que.—Tenders addressed to R. C. Desrochers, secretary, Department of Public Works, Ottawa, will be received until 12 o'clock noon, October 29th, 1919, for the construction of two concrete bridge abutments on River St. Louis, at St. Louis de Gonzague, Beauharnois County, Que. Plans may be seen and specification obtained at the Department of Public Works, Ottawa, at the offices of the district engineers, Shaughnessy Building, Montreal, Que., post office building, Quebec, Que., and at the post office, St. Louis de Gonzague, Que.

St. Thomas, Ont.—A special committee has been appointed by the city council to confer with the Michigan Central Ry. officials with the object of constructing pedestrian subways at street crossings along the railway tracks.

Toronto, Ont.—City council intends to construct a 5-ft. cement concrete sidewalk on Adams Ave., s.s., between Shaw St. and Ossington Ave., at an estimated cost of $1,680.

Toronto, Ont.—City council intends to construct asphalt pavements on parts of Avoca Ave., Carlton St., Dufferin St., Gilmour Ave., Logan Ave., Maria St., Morley Ave., Normandy Boulevard, Park Rd., Rhodes Ave., St. Clemens Ave., at an estimated cost of $172,914; brick block pavements on Rhodes Ave., lane 1st south of Humberside Ave., Morley Ave., Normandy Blvd., estimated cost, $54,394; brick pavements on Park Rd., at estimated cost, $17,439; concrete sidewalks on Durie St. and Pine Ave., estimated cost, $6,858; and concrete curbings on Maria St. and Glendonwynne Rd., estimated to cost $587.

Toronto, Ont.—City council intends to extend Stacy St., from Coxwell Ave. to Rhodes Ave., at an estimated cost of $5,550; also to widen part of Day Ave. at a cost of $2,600.

Winnipeg, Man.—A by-law for the proposed new bridge across Assiniboine River at Maryland will be submitted to the ratepayers on November 28th.

WATER, SEWAGE AND REFUSE

Blenheim Tp., Ont.—Tenders will be received by Hugh Allan, township clerk, Drumbo, Ont., up till noon, October 18th, for the furnishing of 57 ft. of 6-in. tile, 425 ft. of 8-in., 3,275 ft. of 12-in., 1,800 ft. of 14-in. and 281 ft. of 16-in. tile; also for the work necessary in the construction of the Costin drain. Plans and specifications may be seen at the clerk's office.

Courtright, Ont.—The by-law to raise $12,000 for the construction of a waterworks system was defeated by the ratepayers.

Hamilton, Ont.—Dr. James Roberts, M.O.H., will shortly ask the city to provide additional sanitary equipment for filtering city water.

Kincardine, Ont.—Town council decided to install a chlorination plant at the power-house. Clerk, J. H. Scougall.

New Liskeard, Ont.—The town council has authorized its waterworks committee to have the deep well now in use repaired and also to obtain estimates for motors and pumps to link up the artesian well. Clerk, J. I. Dixon.

North Grimsby Tp., Ont.—Tenders will be received at the office of J. W. Tyrrell, township engineer, 7 Hughson St. S., Hamilton, Ont., where plans and specifications may be seen up to 12 o'clock noon, October 18th, for the work of cleaning out and repairing what is known as the Ingram drain, through lots M, D and C, and the adjoining roads in the East Gore of the township of North Grimsby.

Ottawa, Ont.—City council intends to construct tarvia macadam pavements on Stewart St., from Waller St. to Chapel St., estimated cost, $26,191, and on Hastey Ave., from Laurier Ave. to Osgoode St., cost, $7,332.10. Also an asphalt pavement on Besserer St., from Charlotte St. to Wurtemburg St., cost, $5,040.20. City clerk, Norman H. H. Lett.

Ottawa, Ont.—City council intends to construct 9-inch tile pipe sewers in Warren Ave., from Wellington St. to Byron St., estimated cost, $2,098.02; Granville Ave., from Wellington St. to the Ottawa Electric Ry., cost, $2,317.25; Hampton Ave., from Wellington St. to the Ottawa Electric Ry., cost, $2,169.97; Harmer Ave., from Wellington St. to Byron St., cost, $2,330.07; Cooper St., from the west limit of lot 54, Cooper St., to a point 80 ft. west of Elgin St., cost, $978.15; Grove St., from Leonard Ave. to Seneca St., cost, $1,681.70, and Beechwood Ave., from Putman Ave. to a point 65 ft. north, cost, $303.55. City clerk, N. H. H. Lett.

Peterboro', Ont.—City council decided to proceed at once with negotiations for the purchase of a site for the proposed sewage disposal plant. City engineer, R. H. Parsons.

Peterborough, Ont.—City council is considering the construction of sewers on Bethune and McDonnel Streets. City engineer, R. H. Parsons.

Regina, Sask.—The city council referred to the city commissioners a petition for sewer and water on Winnipeg St., between Fourth and Eighth Avenues. City engineer, D. A. R. McCannel.

Toronto, Ont.—The date for receiving tenders for the construction of sewers on College St., Beatrice St. to Palmerston Ave.; College St., Palmerston Ave. to Sapdina Ave.; Bowmore Rd., north limit, Plan 522-E, to Wrenson Rd., has been extended from noon on Tuesday, October 14th, 1919, to noon, Tuesday, October 28th, 1919.

Welland, Ont.—City council has requested the Fire, Water and Light Committee to have a Hydro pump installed as an auxiliary in the waterworks pump house.

West Oxford Tp., Ont.—Tenders for the construction of the service drain, consisting of 3,760 ft. of tile drain, and also for the construction of the Cedar St. drain, consisting of 1,512 ft. of tile drain will be received by F. J. Curry, clerk, R.R. No. 1, Woodstock, Ont., until noon, October 18th, 1919. Plans and specifications may be seen at the office of the township clerk.

York Tp., Ont.—York township has taken up the problem of providing a sewer system for Todmorden and the north Danforth district. At a recent meeting of the township council Engineer R. O. Wynne-Roberts presented a report on the engineering aspect of the scheme, and suggested that an immediate decision be reached on the question of taking care of sewage and storm water in one system or in two systems, and also that a district be mapped out. It was decided to adopt the separate system idea, but the storm sewers will not be installed for some time. The engineer was authorized to take up the question of a site for the disposal plant.

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Burlington Steel Co., Ltd.
Hamilton, Canada

STEEL BARS
For
Concrete Reinforcing

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Portage la Prairie, Man.—Contract for the sub-station of the transmission line to be built here has been awarded by the provincial government to Tremblay, Deniset and Co., of Winnipeg, at $3,357.

Saskatoon, Sask.—City Commissioner C. J. Yorath has recommended that the tender of $149,813 of the Canadian Westinghouse Co., of Hamilton, for the installation of a steam turbine generator and switch-gear, also condenser and equipment at the city power house, be accepted.

Winnipeg, Man.—Tenders addressed to the chairman, Committee on Fire, Water, Light and Power, will be received at the office of C. J. Brown, city clerk, up to 3 o'clock p.m. on Monday, November 3rd, 1919, for the supply and erection in the city power-house at Point du Bois of three 5,000 k.v.a. single-phase step-up transformers, with oil and accessories complete. Specification may be obtained at the office of the City Light and Power Department, 54 King St.

RAILWAYS

Alberni, B.C.—The C.P.R. awarded contract to the Foundation Co. for the building of the extension of their line, from Alberni to Great Central Lake, a distance of 10.2 miles.

Chicoutimi, Que.—In a recent request to the provincial government the residents of Chicoutimi and Lake St. John district asked for a belt railway around the lake, with branches from the Ha Ha Bay road to the Quebec-Saguenay road.

Moose Jaw, Sask.—The C.N.R. has been granted permission by the city to construct a temporary subway on Athabaska St. E., on condition that the company agrees to have the permanent subway completed by the fall of 1920.

Pickering Tp., Ont.—The ratepayers passed the by-law in connection with the construction of the Toronto and Eastern Electric Railway.

Scarboro' Tp., Ont.—The township council decided to submit a by-law to the ratepayers on November 22nd on the building of the Toronto and Eastern Ry. through Scarboro' township. Hydro radial construction to be made, if the by-law carries, will amount to eight or nine miles.

Toronto, Ont.—Active preparations are being made for an early commencement of construction work on the Toronto-Port Credit section of the new Hydro radial line that will form the connecting link with the city, of the Port Credit-St. Catharines line and the Toronto-London line.

Winnipeg, Man.—The Dominion government will start surveying for a railway line to the gold fields in northern Manitoba this fall, according to a statement made by Premier T. C. Norris, who recently returned from Ottawa. The railway will be erected from The Pas to the gold belt, about 73 miles north and will cost approximately $2,000,000.

FACTORIES AND LARGE BUILDINGS

Bassano, Alta.—Tenders will be received by Charles Carnegy, secretary-treasurer, Bassano, up to 5 o'clock p.m. on Saturday, October 18th, 1919, for the various works necessary in the alterations and extensions to the hospital. Plans and specifications may be obtained at the office of the secretary-treasurer or at the office of the architect, Charles Hay, 511 Beveridge Block, Calgary.

Calgary, Alta.—McDougall, Trainor and McNeill, Ltd., have been awarded the contract for the construction of a building for L'Air Liquide Society, at First St. E. and Second Ave. This company is a well-known French concern, which is opening up in this country. The company is also building plants in Winnipeg and Vancouver.

Cobourg, Ont.—The board of trade and town council have been holding conferences with a United States manufacturer who is desirous of establishing a branch factory here. The manufacturer wants the loan of about $75,000 to build a factory, also free site and exemption from taxation. Town clerk, Ben Ewing.

Cobourg, Ont.—The Cross Fertilizer Co., of Sydney, N.S., are looking for a site for the erection of a plant here.

Edmonton, Alta.—The Public Library Board is considering the erection of a new library building. Chairman, Mr. Barclay.

Guelph, Ont.—Card & Gray have decided to erect a new brick two-story building on Woolwich St.

Guelph, Ont.—Contract has been awarded for the masonry work in connection with the construction of the new skating arena to W. E. Taylor.

Guelph, Ont.—The C.P.R. intends to erect a large new freight shed here early next spring.

Halifax, N.S.—A housing company is being incorporated, and will erect fifty houses, contracts for which will be let very shortly.

Hamilton, Ont.—The Canadian Carbonate Co., Ltd., of Montreal, capitalized at $500,000, has purchased a site at the foot of Simcoe St., and will make an immediate expenditure of $100,000 on buildings and equipment. J. R. Colby is general manager.

Hamilton, Ont.—The Firestone Tire and Rubber Co., of Akron, Ohio, will establish their Canadian plant here if the ratepayers of Barton township give their assent to two by-laws which are to be submitted to the electors on November 3rd.

Kincardine, Ont.—The Board of Education requested the council to make a grant of $2,500 for repairs to the High School. It was decided to submit the matter to the ratepayers at the municipal elections.

Levis, Que.—There is some talk here of building a large and modern hotel. The new hostelry would be a six or seven-story structure.

London, Ont.—A movement is on foot for the erection of a $100,000 children's hospital as a war memorial.

London, Ont.—The board of education is considering the question of either enlarging Victoria School and Egerton St. school, or erecting new buildings. Extensions will also be made to Ealing, Colborne St. South and Wortley Rd. schools.

Montreal, Que.—A company has been organized here, to be known as the United Inns of Canada, with a capital of $1,000,000. A Federal charter is being applied for. It is planned to erect inns at points, first through the province of Quebec, and then elsewhere in Canada.

Moose Jaw, Sask.—A movement is on foot for the erection of a $130,000 building for the Great War Veterans' Association. Major McNaughton is convener of the committee in charge of the scheme.

New Liskeard, Ont.—The construction of a large pulp and paper mill is expected to begin next year at the north end of Lake Timiskaming. The M. J. O'Brien, Ltd. a $20,000,000 corporation, which controls the O'Brien mine at Cobalt and the Miller Lake-O'Brien mine at Gowganda, as well as other large interests, is involved in the enterprise.

New Westminster, B.C.—School board is considering the erection of a technical school.

Oshawa, Ont.—Contract for the erection of four additional rooms to Mary St. school was awarded by the Board of Education to Mr. Davidson, of Smith's Falls, at $30,000, exclusive of plumbing and heating.

Oshawa, Ont.—The board of education asked the town council for $35,000 to cover the cost of building an addition to Mary St. school.

Ottawa, Ont.—Controller F. Plant has recommended the enlargement of the market and the building of a cold storage plant, etc.

Ottawa, Ont.—The city council have approved the plans of the new civic hospital committee and have agreed to the

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appointment of Stevens and Lee, of Boston and Toronto, as architects for the new hospital, which is expected to cost about $1,500,000. The firm are to receive 7 per cent. commission. It is expected that a local architect will be appointed by Stevens and Lee, and paid by them to supervise the building. While several sites are under consideration, it is almost certain that the site upon which the General Protestant Hospital now stands will be chosen and additional land secured adjacent thereto.

Peterboro' Ont.—A permit has been issued to the Canadian Chicle Co. for alterations to the Lundy Shovel and Tool building which they have taken over. Cost, $7,000.

Peterboro', Ont.—A recent fire damaged one of the buildings of the Canadian General Electric Co. to the extent of several thousand dollars.

Pickering, Ont.—It is stated that the Provincial Highways Department will erect a machine shop and warehouse here in connection with the building of the eastern division of the provincial highway in these districts.

Portage la Prairie, Man.—A movement is on foot for the erection of a skating rink. Estimated cost, $30,000. Clerk, W. R. Grieve.

Quebec, Que.—A building permit has been issued to Paquet and Co. for the erection of a six-story fireproof steel structure on DesFosses St. Estimated cost, $150,000.

Quebec, Que.—The Champlain Brewery Co. propose to build a new structure at the corner of Crown and Prince Edward Streets. Estimated cost, $100,000.

Quebec, Que.—Damage ranging between $15,000 and $20,000 was caused by fire recently in the Le Mesurier tobacco factory.

Regina, Sask.—City council has agreed to sell the Ford Motor Co. of Canada, Ltd., a site on which the company will erect a $100,000 assembling plant. Construction work will likely commence next spring.

Regina, Sask.—The Saskatchewan Grain Growers may purchase a site from the city for the erection of a large warehouse.

Regina, Sask.—The Williams Motor Co. will build a distributing warehouse and office building on Cornwall St. East. The estimated cost is $20,000. Plans are being prepared by Storey and Van Egmond, and tenders will be called shortly.

Saskatoon, Sask.—A building permit has been issued to W. F. Langstaff, of the Western Fruit Co., for a $3,000 basement construction on 4th Ave. North.

South Vancouver, B.C.—The building of a high school here is imperative, according to the report of the special committee appointed to inquire into the high school situation. Chairman of the special committee, Allen E. Chamberlain.

St. John's, Nfld.—Contract has been let to B. Bowering for the enlargement of the government Tuberculosis Sanatorium on Topsail Rd., and work has started.

St. John, N.B.—The St. John housing board let contract to Rourke and Griffiths, West St. John, for the erection of four self-contained and four semi-detached houses at a total price of $43,240.

St. Thomas, Ont.—Appleford's, Ltd., propose to erect a factory in this city.

St. Thomas, Ont.—It is reported that negotiations have been started by a Toronto firm for a site on Talbot St. on which to erect a large hotel.

Sydney, N.S.—Contract for the erection of a large hotel has been awarded to the Fuller Construction Co., who have already started work.

Smith's Falls, Ont.—The town council has given the first reading to a by-law providing for the borrowing of $60,000 from the provincial government under the Housing Act.

Toronto, Ont.—An offer was placed before the Property Committee of the Board of Education last week for the purchase of the vacant site on the north side of Bloor St. East, opposite St. Paul's Church, to be used for the erection of a large $5,000,000 family hotel. The offer was made by W. J. Hambly on behalf of an American concern.

Toronto, Ont.—G. W. Lucas, 98 Bathgate Ave., has been granted a permit to erect five three-story stores, costing $50,000 on Danforth Ave., near Broadview.

Toronto, Ont.—Separate tenders addressed to T. L. Church, chairman of the board of control, for the work included in the specifications of the several trades mentioned below in connection with the erection and completion of public lavatories at Centre Island, Toronto, will be received up to noon on Tuesday, October 21st, 1919: (1) Mason work; (2) carpenter work; (3) plumbing work; (4) electric wiring and fixtures; (5) plastering; (6) painting. Plans and specifications may be seen at the office of the city architect, City Hall, Toronto.

Toronto, Ont.—The Bank of Nova Scotia has purchased a site at the south-west corner of Queen and Church Sts., for the erection of a branch bank building.

Toronto, Ont.—The Industrial Education Committee has appealed to the city council for the erection of a technical school in the east end of the city.

Toronto, Ont.—Two new bank buildings will be erected in the near future, one being the new Toronto head office of the Merchants Bank at 12-16 King St. West, and a branch of the Dominion Bank on the east side of Yonge, near Hayden St.

Vancouver, B.C.—A permit has been issued to Allan and McKelvie to build an erecting shop at 1214 Pender St. East at a cost of $2,000.

Vancouver, B.C.—A movement is on foot for the erection of a combination Hebrew school and synagogue at an approximate cost of $40,000. For further information address Max M. Grossman.

Victoria, B.C.—Contract has been let for erection of Alberni Indian School to Parfitt Brothers at a cost of $65,000.

Vancouver, B.C.—The Restmore Manufacturing Co. have taken out a permit for $10,000 to build a boiler house and tempering office for their factory at the corner of Parker St. and Glen Drive.

Waterloo, Ont.—An addition to the building of the Mutual Life Assurance Co. of Canada is to be erected immediately.

Welland, Ont.—A plan is on foot by the members of the city and county councils and Great War Veterans' Association for the erection of a $125,000 memorial building. A committee has been appointed of which T. J. Dillon is chairman.

Winnipeg, Man.—A building permit has been issued to the Swift Canadian Co., for the erection of an icehouse on Midwinter St. at a cost of $5,000.

Winnipeg, Man.—Tenders addressed to the chairman, committee on library and public baths, will be received at the office of C. J. Brown, city clerk, up to 3 p.m., October 22nd, 1919, for the supply of labor and materials required in the work of alterations to the dressing-rooms at the Charles St. public baths. Specification may be obtained at the office of the building inspector, corner James Ave. and King St.

Winnipeg, Man.—The Ogilvie Flour Mills Co. will erect a storage shed on Higgins Ave. at a cost of $5,000, and the Salvation Army will erect a citadel on the south-east corner of East St. and Alexander Ave. at a cost of $6,500.

MISCELLANEOUS

Barton Township, Ont.—Ratepayers will vote on a by-law at the next municipal elections for the purchase of stone-crushing equipment. Clerk, A. G. E. Bryant, Hamilton, Ont.

Brandon, Man.—Tenders addressed to R. C. Desrochers, secretary, Department of Public Works, Ottawa, will be received until 12 o'clock noon, Tuesday, October 21st, 1919, for the construction of a new passage between post-office

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and old bank building, and additional post-office fittings in post-office. Plans and specification may be seen at the offices of the Chief Architect, Department of Public Works, Ottawa; the Resident Architect, Lindsay Building, Winnipeg, Man., and the postmaster, Brandon, Man.

Montreal, Que.—A great North American shipbuilding entente between Canada and the United States is foreshadowed by the visit to Montreal recently of David Rodgers, general works manager of the Skinner and Eddy Corporation, Seattle. A part of the scheme is the establishment of a shipbuilding yard at Montreal and at several other points throughout Canada, involving an outlay of millions of dollars. It is understood that contracts for nearly $400,000,000 worth of ships are practically pledged to the proposed company.

Montreal, Que.—Tenders addressed to R. C. Desrochers, secretary, Department of Public Works, Ottawa, and endorsed, "Tender for Montreal, Verdun Postal Station Fittings," will be received until 12 o'clock noon, Thursday, October 23rd, 1919. Plans and specifications may be seen at the offices of the Chief Architect, Department of Public Works, Ottawa, and the Overseer of Dominion Buildings, Montreal, Que.

Oshawa, Ont.—Town council gave third reading to by-laws providing for pavements and sanitary sewers on certain streets. Town engineer, G. W. Worden.

Pointe aux Trembles, Que.—Tenders addressed to R. C. Desrochers, secretary, Department of Public Works, Ottawa, will be received until 12 o'clock noon, Wednesday, November 5th, 1919, for repairs to landing pier. Plans may be seen and specifications obtained at the Department of Public Works, Ottawa; at the offices of the District Engineers, Post-office Building, Quebec, Que.; Shaughnessy Building, Montreal, Que., and at the post-office, Pointe aux Trembles, Que.

St. Francois Sud, Que.—Tenders addressed to R. C. Desrochers, secretary, Department of Public Works, Ottawa, will be received until 12 o'clock noon, Wednesday, November 5th, 1919, for the construction of repairs to the wharf. Plans may be seen and specification obtained at the Department of Public Works, Ottawa; at the offices of the District Engineers, Post-office Building, Quebec, Que.; Shaughnessy Building, Montreal, Que., and at the post-office, St. Francois d'Orleans, Que.

St. John, N.B.—Tenders addressed to R. C. Desrochers, secretary, Department of Public Works, Ottawa, will be received until 12 o'clock noon, Thursday, October 23, 1919 for the construction of grain conveyer equipment, at Berth 15, St. John Harbor, N.B. Plans of contract may be seen and specification obtained at the Department of Public Works, at the offices of the engineer-in-charge, St. John, N.B., district engineers, Shaughnessy Building, Montreal, and Equity Building, Toronto.

Winnipeg, Man.—It has been reported that the Flin Flon low-grade copper mine in northern Manitoba has been bought by Hayden, Stone and Co., of Boston, at a price said to have run into the hundreds of millions of dollars. It is understood that the new owners will proceed at once to build in a railway at an estimated cost of $2,000,000 and erect a $5,000,000 smelter on the property.

Winnipeg, Man.—Tenders addressed to the chairman, Committee on Fire, Water, Light and Power, will be received at the office of C. J. Brown, city clerk, up to 3 o'clock p.m. on Monday, October 20th, 1919, for the supply of labor and materials required for overhauling and renewing the plumbing at the waterworks office at the city yards. Specification may be obtained at the office of the Operating Superintendent of Waterworks, 223 James Ave.

Winnipeg, Man.—Tenders addressed to the chairman, Committee on Library and Public Baths, will be received at the office of C. J. Brown, city clerk, up to 3 o'clock p.m. on Wednesday, October 22nd, 1919, for supply of all labor and materials required in the construction of certain tile work at the Cornish Park Baths. Specification may be obtained at the office of the Building Inspector, corner James Ave. and King St.

Tenders Called For

CITY OF LONDON, ONTARIO

TENDER FOR MOTOR-DRIVEN STREET FLUSHER

Sealed tenders, addressed to the "Chairman and Members, No. 2 Committee," will be received at the office of the City Clerk up to 3 p.m. on Monday, October 27th, 1919, for the supply of one 1,200 U.S. gallon capacity Motor-driven Street Flusher, complete.

Specifications and form of tender, etc., may be obtained at the office of the City Engineer.

Tenders to be accompanied by a marked cheque or a cash deposit for 5% of the amount of tender.

The lowest or any tender not necessarily accepted.

C. R. SOMERVILLE, Mayor. H. A. BRAZIER, City Engineer.

W. A. WILSON, Acting Chairman, No. 2 Committee. 363

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ENGINEER WANTED to take charge of a Buffalo office of a Canadian engineering and contracting firm doing contract work. Duties are partly engineering and partly selling. Good opportunity for live man. Address Box 13, *Canadian Engineer*, Toronto.

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ENGINEER WANTED to take charge of Engineering Department for large pulp and paper company who are making large extension to their development. He must have a good education and years of experience in similar position. He must have good executive ability, experience in making out specifications and contracts and in buying. Salary, $10,000 a year. With applications pleace give information in detail as to education, experience, age, married or single, and copy of references. Address Box 15, *Canadian Engineer*, Toronto.

COMMISSARY work for construction undertakings is my specialty. Before entering this line, I had eight years' experience as an accountant in the Canadian Bank of Commerce in Toronto and other Canadian cities. Am a Canadian, married, good references. During last year of war had entire charge of all feeding and living accommodations, timekeeping, etc., for large shipbuilding corporation in United States. Interview solicited. Address Box 398, *Canadian Engineer*, Toronto.

The Canadian Engineer

A Weekly Paper for Civil Engineers and Contractors

Classification and Salaries of Engineers

Toronto Engineers Adopt Schedule of Titles, Qualifications and Minimum Salaries for Technically-Trained Men Employed by Railways, Municipalities, Industries, Public Works and Large Public Utilities—Salaries Range from $1,200 to $12,000 Per Annum

AT a meeting held last Thursday evening, the members of the Toronto branch of the Engineering Institute of Canada approved of the schedule prepared by the Salaries Committee of that branch. This schedule classifies engineers employed by railways, municipalities, industrial firms, large public utilities and the Public Works Department of Canada. It groups the engineers employed in these five lines of work in clear-cut classes, with non-conflicting titles, and states the qualifications deemed requisite for each class, and also states the minimum salary which, in the opinion of the members of the branch, should be paid to each class.

In some of the classifications, the minimum salary stated in the schedule does not exceed that which prevails at present on the most important works in Canada, but in general the classification, if adopted by employers, will mean a most substantial increase for many engineers, especially when it is borne in mind that the salary mentioned in the schedule is meant to be the minimum salary to be paid in any case.

The schedule, having now been adopted by the Toronto branch, will be sent to every one of the other branches of the Institute throughout Canada for comment and to aid them in the preparation of similar schedules. Many of the other branches of the Institute have committees at work upon similar schedules, although no other branch, so far as is known, has as yet definitely completed a schedule. The Niagara Falls, Ont., branch is said to have made very great progress in the preparation of a schedule. The branches in the maritime provinces and also many of those in the western povinces have discussed the desirability of uniform classification.

The Toronto schedule will also be forwarded to the council of the Institute at Montreal, with a recommendation that it be formally adopted by the Institute as a whole.

Personnel of Salaries Committee

The personnel of the Salaries Committee of the Toronto branch is as follows:—

Geo. Clark (chairman), designing engineer, Toronto Harbor Commission; H. A. Goldman (secretary), assistant engineer, Toronto Harbor Commission; L. M. Arkley, assistant professor of mechanical engineering, University of Toronto; N. L. Crosby, contracting engineer, Toronto Structural Steel Co.; F. B. Geodike, assistant engineer, railway department, Hydro-Electric Power Commission of Ontario; E. G. Hewson, railway engineer, Hydro-Electric Power Commission of Ontario; Thomas Hogg, assistant hydraulic engineer, Hydro-Electric Power Commission of Ontario; H. J. Lamb, superintending engineer for Ontario, Department of Public Works of Canada; James Milne, mechanical and electrical engineer, works department, city of Toronto; G. G. Powell, deputy city engineer, Toronto; A. F. Stewart, chief engineer, Canadian National Railways; and Thomas Taylor, designing and construction engineer, Bloor St. Viaduct, Toronto.

Andrew Harkness, consulting structural engineer, Toronto, who is chairman of the Toronto branch, and W. S. Harvey, engineer of sewers, Toronto Harbor Commission, who is secretary of the Toronto branch, are ex-officio members of the committee.

Approximately, 60 members of the branch were present at the meeting last Thursday evening, Mr. Harkness presiding. After the routine business had been quickly finished, Mr. Clark was asked to present the report of the Salaries Committee, which had been considering the proposed classification and schedule of salaries for the past six months.

After Mr. Clark had read the schedule in regard to railway work, Mr. Harkness enquired regarding the present rate of pay received by railway brakemen, and was informed by Mr. Clark that it amounts to between $300 and $330 per month.

J. R. W. Ambrose, chief engineer of the Toronto Terminal Railway Co., enquired as to how the schedule of salaries recommended by the committee compares with the schedule used by the American Association of Engineers, and was informed that the proposed Toronto schedule is about $200 per annum higher than that of the American Association.

Railway Salaries are Discussed

The only change made in the railway classification was to substitute the title "Designing Engineer in Structural Department," for "Leading Draftsman in Structural Department."

Mr. Ambrose contended that rodmen should receive more than chainmen, as they are considered on the railways to be superior to chainmen. Mr. Clark, however, expressed the opinion that men employed for this class of work are largely from high schools or else are junior students at the universities, and may all be considered as equal in ability, but the members decided to support the increase for rodmen as proposed by Mr. Ambrose.

The railway salaries reported by the committee were unanimously adopted excepting for the following changes: Assistant Bridge Engineer $4,800 instead of $4,200; Designing Engineer in Structural Department, $3,600 instead of $3,000; Rodman, $1,500 instead of $1,200.

Frank Barber, consulting engineer, Toronto, enquired as to how officials such as county engineers and road commissioners should be scheduled in view of the fact that some of them are only employed part time and that others are not qualified engineers, and that the conditions of employment differ so greatly in the various cases. Mr. Clark stated that these matters are covered by the municipal schedule.

J. C. Krumm, railway bridge designer, Hydro-Electric Power Commission of Ontario, said that in respect to bridge engineers the railway schedule does not conform to what he considers to be the usual distinction between the various classes of technically-trained men, and he proposed that the schedule be referred back to the committee for revision. This was not carried, however, as G. A. McCarthy, engineer of railways and bridges, city of Toronto, and many other expressed the view that the classification regarding bridge engineers is satisfactory and should not be changed.

Mr. McCarthy objected, however, to the qualification requiring bridge engineers to be college graduates; he thought that it would be somewhat severe to confine future appointments in bridge work solely to men who are graduates of universities. He stated that he knows some very able bridge engineers who are not college graduates. He moved, with Mr. Ambrose as seconder, that the wording "should be a college graduate" be changed to "should preferably be a college graduate," and it was decided to make this change throughout all of the classifications excepting that relating to public works. The public works classification is that which had been adopted by the Civil Service Commission of Canada, and it had been accepted in its entirety by the Salaries Committee of the Toronto branch, therefore no changes were made in the classification relating to that field of work.

Discussion on Municipal Salaries

After Mr. Clark had read the schedule relating to municipal work, R. E. W. Hagarty, consulting engineering Toronto, expressed the opinion that the salaries should be increased by 25%, especially the lower salaries. George Hogarth, chief engineer, Ontario Highways Department and and R. O. Wynne-Roberts, consulting engineer, Toronto, believed that the salaries of deputy city engineers, first assistants and second assistants should be increased.

Mr. Clark stated that the present depreciation in value of the dollar should not be taken too much into account in determining a permanent schedule of minimum salaries, and that due regard should be paid to the circumstances of individual employment and to the value of services rendered in other fields of engineering work of similar nature. After debate, the members decided to add $600 per annum to the salary of chief engineers of municipalities of less than 100,000 population, $400 per annum to the salary of first assistants in cities between 100,000 and 300,000 population, and $600 per annum to the salary of designers.

F. A. Dallyn, sanitary engineer, Ontario Board of Health, expressed the opinion that the experience required is just as great for cities of 7,000 population as for those of 10,000 population, and he thought the dividing point should be at 7,000 instead of 10,000. No motion to this effect was made, however.

Public Works Schedule Altered

The industrial, public utilities and public works schedules were adopted without much discussion, no changes being made in the industrial or public utilities schedules. It was emphasized, however, that the classification and salaries mentioned for public utilities can be considered effective only for the larger type of public utilities, and that it is not practical at present to recommend their strict observance by small public utilities.

In the public works schedule, the following changes in salaries were made: Senior Assistant Engineer, $3,200 instead of $2,700; Resident Engineer, $3,140 instead of $2,640; Chief Draughtsman, $2,500 instead of $2,280; Inspector, $1,800 instead of $1,500; Draughtsman, $1,500 instead of $1,200; Junior Instrumentman, $1,500 instead of $1,200.

Following is the schedule as finally adopted by the Toronto branch, the salary figures mentioned in each case being the minimum salary, which in the industrial schedule is supposed to be graded according to the size of the industry:—

Railway Schedule

1. Chief Engineer, $10,000.
2. Assistant Chief Engineer, $7,200.

3a. Engineer of Maintenance, $6,600. Should preferably be a graduate from an engineering school recognized by the Institute, and should have 8 to 10 years' practical experience in engineering work, or, if not a graduate, should have from 12 to 15 years' practical experience, and should be thoroughly familiar with the mathematics of engineering.

3b. Engineer of Construction, $6,600. Same qualification as for Engineer of Maintenance.

3c. Bridge Engineer, $6,000. Same qualification as for Engineer of Maintenance.

3d. Principal Assistant Engineer, $6,000. Same qualification as for Engineer of Maintenance.

4a. District Engineer, $4,800. Should preferably be a graduate from an engineering school recognized by the Institute, and should have 6 to 8 years' practical experience in engineering work, or, if not a graduate, should have from 10 to 12 years' practical experience, and should be familiar with the mathematics of engineering.

4b. Signal Engineer, $4,800. Should preferably be thoroughly familiar with the theory and practice of signalling, and of train operation, and should have had, in addition, at least five years' practical experience in mechanical and electrical signal work on railways.

4c. Architect or Engineer of Buildings, $4,000. Should have sufficient architectural training to design railway stations, shops, round-houses, dwellings, etc., of normal types, and should have 6 or 8 years' practical experience in responsible design of railway buildings.

4d. First Assistant Engineer, $4,200. Same qualification as for District Engineer.

4e. Assistant Bridge Engineer, $4,800. Should preferably be a graduate engineer with from 5 to 6 years' practical experience in the office and in the field.

5a. Division Engineer, $3,600. Should preferably be a graduate engineer with 3 or 4 years' experience of practical engineering, or, if not a graduate, should have 8 to 10 years' practical experience and should be well grounded in the mathematics of engineering.

5b. Second Assistant Engineer, $3,000. Same qualification as for Division Engineer.

5c. Chief Draughtsman, $2,500. Should have a thorough knowledge of general draughting, but not necessarily knowledge of design, and should be able to control a number of subordinates and supervise their work.

5d. Designing Engineer in structural department, $3,600. Should be thoroughly grounded in the theory of design and detail in his particular department, and should be able to control a number of subordinates and supervise their work.

5e. Leading Draughtsman in architectural department, $2,400. Same qualification as given for Designing Engineer in structural department.

5f. Signal Supervisor, $2,400. Should be thoroughly familiar with the mechanical and electrical details of signalling, should have sound elementary knowledge of the principles of signalling, and should be qualified to carry out and supervise construction and maintenance of all types of signal plants.

6a. Resident Engineer (construction only), $2,700 and expenses. Should preferably be graduate engineer or have 3 or 4 years' practical experience in the junior branches of engineering work.

6b. Third Assistant Engineer, $2,400. Same qualification as for Resident Engineer.

6c. Draughtsman, $1,800. Should be able to plot accurately from field notes or notes and sketches supplied to him by a senior officer.

6d. Inspector (class A), $2,400 and expenses. Should have a thorough knowledge of the class of work that he is employed to inspect, and in the case of steel or reinforced concrete structures, should be a man of sufficient intelligence to understand the elementary principles of design and realize the necessity for close adherence to plans, and must be able to read and interpret plans correctly.

7a. Junior Assistant or Instrument Man, $1,800 and expenses. Should have sufficient training in the use of level or transit, or both, to do accurate work at a reasonable rate of speed, and should be thoroughly grounded in the mathematics required

for the proper reduction and application of his instrumental work.

7b. Inspector (class B), $1,800. Should have some practical experience in the class of work that he is employed to inspect, and have sufficient intelligence and firmness to enforce the carrying out of specifications.

7c. Junior Draughtsman, $1,500. Should have passed through his training as a tracer, and should have working knowledge of the use of draughting instruments.

8a. Chainman, $1,200. No previous experience required.

8b. Rodman, $1,500. No previous experience required.

8c. Tracer, $1,200. No previous experience required.

Municipal Schedule

1a. Chief Engineer of municipality greater than 300,000 population, $12,000. Should preferably be a graduate from an engineering school recognized by the Institute, and should have had 15 years' practical experience, covering two branches in municipal engineering, and should have served for about 5 years in the capacity of Deputy City Engineer, or of First Assistant in municipalities of over 300,000, or as Chief Engineer in municipalities of over 100,000, and should possess proven executive ability.

1b. Chief Engineer, 100,000 to 300,000, $8,000. Should preferably be a graduate with 10 years' experience, covering two branches in municipal engineering. Three years of his experience should be in the capacity of either one of the following:—Chief Engineer in municipality of over 50,000, First Assistant in municipality of over 100,000, or Second Assistant in municipality of over 300,000. He should possess proven executive ability.

1c. Chief Engineer, 50,000 to 100,000, $6,600. Should preferably be a graduate with 8 years' experience in municipal engineering, 2 years of which should be in the capacity of any one of the following:—Chief Engineer in city of over 10,000, First Assistant in city less than 100,000, or Second Assistant in city under 300,000. He should possess proven executive ability.

1d. Chief Engineer, 25,000 to 50,000, $5,400. Should preferably be college graduate or licensed land surveyor with 5 years' experience in municipal engineering, and possess proven organizing ability.

1e. Chief Engineer, 10,000 to 25,000, $4,200. Should preferably be college graduate or licensed land surveyor with 3 years' experience in municipal engineering, or should have completed apprenticeship to municipal engineer, and have been subsequently placed in responsible charge of engineering work. He must have ability to handle men.

1f. Chief Engineer, less than 10,000, $3,000. Same qualifications as for cities between 10,000 and 25,000 unless work is confined to routine construction and maintenance, in which case he should have had 5 years' experience as First Assistant in similar work, and should have ability to handle men.

1g. Other Municipal Engineers (employed part time), Daily Rate. Land Surveyors,—requirements prescribed by law. For routine construction and maintenance, qualification to be same as for Chief Engineer of city less than 10,000. Other casual work probably done by consulting engineers.

2. Deputy City Engineer or Principal Assistant in cities over 300,000, $8,000. Same qualification as for Chief Engineer in city of from 100,000 to 300,000.

3a. First Assistant having charge of (any one of the following) roadways, sewers, water works, light, transportation, structures, testing and inspection in cities over 300,000, $5,000. Should preferably be a graduate with 8 years' experience in municipal engineering, 4 years of which should have been in the capacity of First Assistant in municipality of 100,000 to 300,000, or, as Second Assistant in municipality of over 300,000. Should be able to handle office, construction and maintenance forces.

3b. First Assistant in charge of one or more departments in cities 100,000 to 300,000, $4,000. Should preferably be a graduate with 6 years' experience in engineering, 2 years of which should have been in the capacity of First Assistant in city of less than 100,000, or, as Second Assistant in city of over 100,000. Should be able to handle office, construction and maintenance forces.

3c. First Assistant in cities less than 100,000, $3,000. Should preferably be a graduate with 4 years' experience in engineering, 2 years of which should have been in the capacity of Second Assistant, and should be able to handle office, construction and maintenance forces.

4a. Second Assistant reporting to the First Assistants in larger municipalities and to the Chief Engineer in smaller municipalities, in responsible charge of design, drafting and engineering records, cities over 300,000, $3,600. Should preferably be a graduate with 6 years' experience in engineering, 4 years of which should have been as Second Assistant in city under 300,000, or as Resident Engineer on construction with designing experience, or as Designer. Should be able to handle office staff for designing, drafting and keeping records.

4b. Second Assistant in responsible charge of design, drafting and engineering records, cities less than 300,000, $3,000. Should preferably be a graduate with 4 years' experience in engineering, 2 years of which should have been either as Designer or as Resident Engineer on construction with designing experience. Should be able to handle office staff for designing, drafting and keeping of records.

4c. Second Assistant in responsible charge of surveys, cities over 300,000, $3,000. Should preferably be a graduate engineer or licensed land surveyor with 4 years' experience as Instrument man in municipal work, preferably on construction, and should be able to handle several parties and to keep them employed to advantage.

4d. Second Assistant in responsible charge of surveys, cities less than 300,000, $2,400. Should preferably be a graduate engineer or licensed land surveyor with 2 years' experience as Instrument man in municipal work, preferably on construction, and should be able to handle several parties and keep them employed to advantage.

4e. Second Assistant in responsible charge of construction, operation or maintenance (one or more), cities more than 300,000, $3,600. Should preferably be a graduate with 6 years' experience in engineering, 4 of which should have been as Inspector or as Resident Engineer on construction, and should be able to handle construction and maintenance forces.

4f. Second Assistant in responsible charge of construction, operation or maintenance (one or more), cities less than 300,000, $3,000. Should preferably be a graduate with 4 years' experience in engineering, 2 of which should have been as Inspector or as Resident Engineer on construction, and should be able to handle construction and maintenance forces.

5. Resident Engineer on construction, $2,400. Should preferably be graduate with 3 years' experience in municipal work, or should have completed apprenticeship in municipal work. Should have ability to use survey instruments, make calculations arising therefrom, and keep track of quantities and labor.

6. Designer, $3,000. Should preferably be a graduate with 4 years' experience, and should be familiar with the mathematics and practice of the branch of work in question.
7. Draughtsman, $1,800. Should be high school or preferably a college graduate, and should be able to plot accurately from field notes and produce correct working drawings from designer's sketches and computations.
8. Inspector, $2,100. Should have a thorough knowledge of the class of work that he is employed to inspect, and in the case of steel or reinforced concrete structures, should be a man of sufficient intelligence to understand the elementary principles of design and realize the necessity for close adherence to plans, and must be able to read and interpret plans correctly.
9. Instrument Man, $1,800. Should be high school or preferably a college graduate and should have sufficient training in the use of level or transit, or both, to do accurate work at a reasonable rate of speed, and should be thoroughly grounded in the mathematics required for the proper reduction and application of the instrumental work. In case of construction he should understand the special requirement for the class of work in question.
10. Chainman or Rodman, $1,200. No previous experience required.
11. Tracer, $1,200. No previous experience required.

Industrial Schedule

1a. Chief Engineer, $10,000 down to $3,600.
1b. Research Engineer, $10,000 down to $3,600. Should preferably be a graduate from an engineering school recognized by the Institute, with from 10 to 15 years' experience in his special line.
1c. Mechanical Engineer, $10,000 down to $3,600. Same qualification as for Research Engineer.
1d. Electrical Engineer, $10,000 down to $3,600. Same qualification as for Research Engineer.
1e. Chemical Engineer, $10,000 down to $3,600. Same qualification as for Research Engineer.
1f. Metallurgical Engineer, $10,000 down to $3,600. Same qualification as for Research Engineer.
2a. Assistant Chief Engineer (in large industries only), 75% of salary of Chief Engineer, with a minimum of $3,000. Preferably technical graduate with from 5 to 10 years' experience.
2b. Engineer in general charge of all outside construction, 75% of salary of Chief Engineer, with a minimum of $3,000. Preferably technical graduate with from 5 to 10 years' experience.
2c. Efficiency Engineer (usually a consulting engineer, but occasionally on the permanent staff), 75% of salary of Chief Engineer, with a minimum of $3,000.
3a. Designing Engineer, having responsible charge of all design in mechanical engineering, 50% of salary of Chief Engineer, with a minimum of $2,700. Should preferably be a technical graduate with 5 years' practical experience in his special line, or, should be a high school graduate with 10 years' practical experience, and should have a good general knowledge of mathematics and the fundamental physical laws used in engineering.
3b. Designing Engineer, having responsible charge of all design in electrical engineering, 50% of salary of Chief Engineer, with a minimum of $2,700. Same qualification as for mechanical engineering.
3c. Designing Engineer having responsible charge of all design in structural engineering, 50% of salary of Chief Engineer, with a minimum of $2,700. Same qualification as for mechanical engineering.
3d. Designing Engineer having responsible charge of all design in heating and ventilating engineering, 50% of salary of Chief Engineer, with a minimum of $2,700. Same qualification as for mechanical engineering.
4a. Engineer in charge of estimating, figuring costs, etc., 35% of salary of Chief Engineer, with a minimum of $2,400. Should preferably be a technical graduate with 3 years' practical experience in his special line, or, should be a high school graduate with 8 years' practical experience, and should have a good general knowledge of mathematics and the fundamental physical laws used in engineering.
4b. Testing Engineer in charge of tests, 35% of salary of Chief Engineer, with a minimum of $2,400. Same qualification as for Engineer in charge of estimating.
4c. Resident Engineer on construction, 35% of salary of Chief Engineer, with a minimum of $2,400. Same qualification as for Engineer in charge of estimating.
4d. Chief Draughtsman responsible for all working drawings, 35% of salary of Chief Engineer, with a minimum of $2,400. To be qualified by training and experience for the special work required of him.
4e. Designer, assistant to Designing Engineer, 35% of salary of Chief Engineer, with a minimum of $2,400. Should preferably be a technical graduate with 2 years' practical experience, or should be a high school graduate with 4 years' practical experience, and should have a good general knowledge of mathematics and the fundamental physical laws used in engineering.
5a. Estimator, assistant to Engineer in charge of estimating, $2,400. Should preferably be a technical graduate with 2 years' practical experience, or should be a high school graduate with 3 years' practical experience, and should have a good general knowledge of mathematics and the fundamental physical laws used in engineering.
5b. Squad Boss in charge of small squad of Draughtsmen, $2,400. Should be a high school graduate with 3 years' practical experience, 1 year as checker, and should have a good general knowledge of mathematics and the fundamental physical laws used in engineering.
6a. Chief Shop Inspector in charge of shop inspection, $2,100. Should preferably be a technical graduate with 1 year's experience, or should be a high school graduate with 3 years' experience as inspector, and should have a good general knowledge of mathematics and the fundamental physical laws used in engineering.
6b. Checker, responsible for the correctness of working drawings, $2,100. Similar qualification as for Chief Shop Inspector.
7a. Draughtsman, making detailed working drawings, $1,800. Should preferably be a technical graduate, or 3 years' experience in drawing, tracing, etc.
7b. Shop Inspector, $1,800. Should have some practical experience in the class of work that he is employed to inspect, and have sufficient intelligence and firmness to enforce carrying out of specifications.
7c. Field Inspector, $1,800. Same qualification as for Shop Inspector.
8. Tracer, $1,200. No previous experience required.

Public Utility Schedule

1. Chief Engineer, $12,000.
2. Assistant Chief Engineer, $9,000.
3a. Departmental Engineer having charge of surveys, specifications for and design of hydraulic structures, drafting and engineering records, and hydrometric records, $7,500. Should preferably be a graduate from an engineering school recognized

by the Institute, with from 10 to 15 years' experience in his particular work.

3b. Departmental Engineer having charge of specifications for, and design of, electrical work, substations, powerhouses and switching stations, $7,500. Same qualifications as for 3a.

3c. Departmental Engineer having charge of surveys and design of transmission lines, high tension and low tension, $5,000. Same qualifications as for 3a.

3d. Departmental Engineer having charge of construction, $7,500. Should preferably be a graduate from an engineering school recognized by the Institute, with from 10 to 15 years' experience on construction, with requisite executive ability to organize and handle large forces of men on the various works indicated by 3a, 3b and 3c.

3e. Departmental Engineer having charge of research and tests, $5,000. Same qualifications as for 3a.

3f. Departmental Engineer having charge of operation and maintenance, $7,500. Same qualifications as for 3a.

3g. Departmental Engineer having charge of power contracts, $5,000. Same qualifications as for 3a.

4a. Deputy Departmental Engineer having charge of surveys, specifications for and design of hydraulic structures, drafting and engineering records and hydrometric records, $4,800. Should preferably be a graduate from an engineering school recognized by the Institute, with 8 years' experience in his particular work.

4b. Deputy Departmental Engineer having charge of specifications for and design of electrical work, substations, powerhouses and switching stations, $4,800. Same qualifications as for 4a.

4c. Deputy Departmental Engineer having charge of surveys for and design of transmission lines, high tension and low tension, $3,000. Same qualifications as for 4a.

4d. Deputy Departmental Engineer having charge of construction, $4,800. Same qualifications as for 4a.

4e. Deputy Departmental Engineer having charge of research and tests, $3,000. Same qualifications as for 4a.

4f. Deputy Departmental Engineer having charge of operation and maintenance, $4,800. Same qualifications as for 4a.

4g. Deputy Departmental Engineer having charge of power contracts, $3,000. Same qualifications as for 4a.

5a. Assistant Departmental Engineer having charge of design of hydraulic structures and records, $3,600. Should preferably be a graduate from an engineering school recognized by the Institute, with 4 years' experience in his particular work.

5b. Assistant Departmental Engineer having charge of power surveys and field engineering on construction, $3,000. Same qualifications as for 5a.

5c. Assistant Departmental Engineer having charge of hydrometric investigation and records, $2,400. Same qualifications as for 5a.

5d. Assistant Departmental Engineer having charge of specifications for and design of electrical work, $3,600. Same qualifications as for 5a.

5e. Assistant Departmental Engineer having charge of specifications for and design of buildings, $3,000. Same qualifications as for 5a.

5f. Assistant Departmental Engineer having charge of field engineering on construction, $2,400. Same qualifications as for 5a.

5g. Assistant Departmental Engineer having charge of design of high tension lines, $3,000. Same qualifications as for 5a.

5h. Assistant Departmental Engineer having charge of design of low tension lines, $2,700. Same qualifications as for 5a.

5i. Assistant Departmental Engineer having charge of surveys for and field engineering on transmission lines, $2,400. Same qualifications as for 5a.

5j. Assistant Departmental Engineer having charge of construction of hydraulic structures, $3,000. Same qualifications as for 5a.

5k. Assistant Departmental Engineer having charge of construction of electrical work, $3,000. Same qualifications as for 5a.

5l. Assistant Departmental Engineer having charge of construction of building, $2,400. Should be a high school graduate with 5 years' experience in building trades.

5m. Assistant Departmental Engineer having charge of electrical testing, $2,400. Same qualifications as for 5a.

5n. Assistant Departmental Engineer having charge of structural testing, $2,400. Same qualifications as for 5a.

5o. Assistant Departmental Engineer having charge of chemical testing, $2,400. Same qualifications as for 5a.

5p. Assistant Departmental Engineer having charge of field and shop inspection, $2,400. Same qualifications as for 5a.

5q. Assistant Departmental Engineer having charge of operations of district or system, $3,000. Same qualifications as for 5a.

5r. Assistant Departmental Engineer having charge of power contracts of district or system, $2,400. Same qualifications as for 5a.

5s. Assistant Departmental Engineer having charge of right-of-way surveys, $2,700. Same qualifications as for 5a, and should hold his provincial land surveyor's certificate.

5t. Assistant Departmental Engineer having charge of cost estimates and power estimates, $2,400. Same qualifications as for 5a.

6. Designer or layout man, $2,400. Should preferably be a graduate from an engineering school recognized by the Institute with 2 years' experience.

7. Draughtsman, Instrument Man and Inspector, $1,800. Should preferably be a technical graduate, or 3 years' experience.

8. Tracer and Chainer, $1,200. No previous experience required.

Public Works Schedule

1. Chief Engineer, $12,000. Graduation in engineering from a school of applied science of recognized standing; at least 12 years of experience in engineering survey, design, estimate and construction work, 7 years of which shall have been in responsible charge of such work; thorough knowledge of Canadian engineering problems; the highest degree of administrative ability.

2. Assistant Chief Engineer, $8,000. Graduation in engineering from a school of applied science of recognized standing; at least 10 years of experience in engineering design, estimate, construction and maintenance work, 5 years of which shall have been in responsible charge of such work; thorough knowledge of dredging work and the general engineering problems of Canada; ability to organize, supervise, and manage large engineering works.

3. Supervising District Engineer, $6,000. Education equivalent to graduation in engineering from a school of applied science of recognized standing; at least 7 years of experience in engineering survey, design, estimate, construction and maintenance work, 4 years of which shall have been in responsible charge of such work; considerable knowledge of marine engineering work; ability to make constructive criticisms and reports on proposed works and supervise the construction of large works.

4. Senior Engineer, $5,000. Education equivalent to graduation in engineering from a school of applied science of recognized standing; at least 7 years of experience in engineering design, estimate, and construction work, 4 years of which shall have been in responsible charge of such work; wide knowledge of public works construction and maintenance work and ability to manage and supervise engineering works of considerable importance.
5. District Engineer (grade 2), $4,000. Education equivalent to graduation in engineering from a school of applied science of recognized standing; 5 years of experience in engineering estimate, survey and construction work, 2 years of which shall have been in responsible charge of such work; preferably thorough knowledge of local conditions and works; firmness, tact, good judgment and ability to manage men.
6. District Engineer (grade 1), $3,500. Same qualifications as for District Engineer (grade 2).
7. Dredging Engineer, $3,500. Education equivalent to graduation in engineering from a school of applied science of recognized standing; at least 5 years of experience in engineering survey, consrtuction, dredging, and maintenance of a dredging fleet, 3 years of which shall have been in responsible charge of such work; thorough knowledge of dredging operations; firmness, tact and ability to manage men.
8. Engineer Ottawa River Storage, $3,300. Education equivalent to graduation in engineering from a school of applied science of recognized standing; at least 5 years of experience in engineering survey, construction, and maintenance, 3 years of which shall have been in responsible charge of such work; thorough knowledge of river regulation works; firmness, tact, good judgment and ability to manage men.
9. Senior Assistant Engineer, $3,200. Education equivalent to high school graduation; either graduation in engineering from a school of applied science of recognized standing, with 3 years of experience in engineering design, estimate, and construction work, 2 years of which shall have been in a position of professional responsibility; or 5 years of practical experience in engineering design, estimate, and construction work, 2 years of which shall have been in a position of professional responsibility; firmness, tact, good judgment, and ability to manage men.
10. Resident Engineer, $3,140. Education equivalent to high school graduation; either graduation in engineering from a school of applied science of recognized standing with 3 years of experience in engineering design, estimate, and construction work, 2 years of which shall have been in a position of professional responsibility; or 5 years of practical experience in engineering design, estimate, and construction work, 2 years of which shall have been in a position of professional responsibility; thorough knowledge of railway and harbor works; tact, good judgment, and ability to manage men.
11. Chief Draughtsman, $2,500. Education equivalent to high school graduation; either graduation in engineering from a school of applied science of recognized standing with 4 years of experience in an engineering draughting office, 3 years of which shall have been in responsible charge of such work, or 6 years of experience in an engineering draughting office, 3 years of which shall have been in responsible charge of such work; ability to visualize proposed engineering works; familiarity with various types of structures which will best serve local needs; firmness, tact and ability to manage men.
12. Assistant Engineer, $2,100. Education equivalent to high school graduation; either graduation in engineering from a school of applied science of recognized standing with 3 years of engineering experience, 1 year of which shall have been in a position of professional responsibility; or 5 years of engineering experience, 1 year of which shall have been in a position of professional responsibility; firmness, tact and ability to manage men.
13. Chief Inspector, $2,100. Education equivalent to graduation in engineering from a university of recognized standing; at least 4 years of supervisory experience in general construction work; supervisory ability, integrity, tact and good judgment, good physical condition.
14. Junior Engineer, $1,800. Education equivalent to high school graduation; either graduation in engineering from a school of applied science of recognized standing with 2 years of engineering experience, or 4 years of engineering experience in design, estimate, construction, and maintenance work.
15. Inspector, $1,800. Education equivalent to high school graduation; at least 2 years of experience in building construction work; ability to read and interpret blue prints and to judge concrete mixtures; supervisory ability, integrity.
16. Instrument Man, $1,800. Education equivalent to high school graduation, attendance for 2 years at a school of applied science of recognized standing, or passing of the preliminary Dominion Land Surveyors' examination with 1 year of experience as Rodman or Junior Instrument Man, or 3 years of experience in a survey party as Rodman or Junior Instrument Man; thorough knowledge of the transit and level and ability to make all adjustments to either instrument.
17. Draughtsman, $1,500. Education equivalent to high school graduation; either attendance for 2 years at a school of applied science of recognized standing with 1 year of subsequent experience in a draughting office, or 3 years of experience in a draughting office; ability to make neat, accurate, and complete plans and drawings from notes or sketches.
18. Junior Instrument Man, $1,500. Education equivalent to high school graduation; either a course of 1 year in engineering in a school of applied science of recognized standing with the passing of the preliminary provincial or Dominion Land Surveyors' examination, and 1 year of training with a survey party, or 2 years of training with a survey party.
19. Engineering Helper, $1,200. Preferably primary school education; willingness and energy; in some cases a good sense of direction and locations and ability to handle a boat or canoe; good physical condition.

[NOTE.—For typographical convenience, minor changes in the form of the schedules have been made in their presentation above, particularly in the numbering and lettering ahead of the titles and in the repetition or omission of portions of titles, but we believe that these changes are not material, and that they do not in any way alter the exact meanings expressed and implied in the original form of the schedules.—EDITOR.]

It is rumoured in Kingston, Ont., that Prof. Clark will be appointed dean of the School of Science, Queen's University, succeeding Dean Goodwin, who has retired.

With the nationalization of the Grand Trunk lines almost an accomplished fact, an agitation has begun for the purchase by the Dominion government of the Edmonton, Dunvegan & Peace River Railway. This line was constructed by J. D. McArthur, and its bonds were guaranteed by the province of Alberta. The owners of the road are said to be unable to carry it on and the settlers in the Peace river valley are complaining of poor service. The provincial government is unwilling to take over or operate the road.

Joint Town-Planning Conference at Ottawa

American City Planning Institute and Town-Planning Institute of Canada Discuss Zoning, Cost of Public Utilities and Street Improvements, Proper Widths for Streets and Other Fundamental Considerations of City and Town Planning

WITH the co-operation of the Commission of Conservation of Canada, a joint conference of the Town Planning Institute of Canada and the American City Planning Institute was held last Friday and Saturday at the Chateau Laurier, Ottawa, Ont.

The conference opened at 2 p.m. Friday. The sessions Friday afternoon, Friday evening and Saturday morning were arranged by the American City Planning Institute. The Saturday evening session was arranged by the Town Planning Institute of Canada. Saturday afternoon was reserved for drives and a visit to the Parliament Building.

After addresses of welcome by Hon. N. W. Rowell, president of the Privy Council, and Mayor Fisher, of Ottawa, reports were submitted by F. L. Olmsted (see next column) and B. A. Haldeman (see page 409 of this issue).

E. H. Bassett's report (see page 410 of this issue) was the chief topic for discussion on Friday evening.

The Saturday morning session was devoted to discussion of A. C. Comey's report, which will appear in the next issue of *The Canadian Engineer*, and Morris Knowles' report (see page 404 of this issue).

Address by Ottawa Planners

At noon Saturday the members were the guests at luncheon of the Canadian Club of Ottawa, and in the evening they were the guests at dinner of the Commission of Conservation and the city council of Ottawa.

Addresses by Thos. Adams and Noulan Cauchon, both of Ottawa, were the features of the final session, Saturday evening.

There was a very representative attendance of some of the leading town planners of Canada and the United States and all were enthusiastic regarding the benefits that will ensue as a result of this international conference.

In the addresses of welcome by Hon. Mr. Rowell and Mayor Fisher, both speakers laid stress on the advantages of international conferences of this nature, especially in the newer centres where development is rapid and the opportunity is great for housing more nearly approaching the ideal.

The committee reports relating to fundamental town planning principles, which comprised the greater portion of the program, were concise statements of about 1,000 words each, but the chairman of each committee elaborated upon his report when reading it.

While meeting in the main with the approval of the conference, these reports were not definitely adopted by the American City Planning Institute and are to be further considered.

Interesting discussion followed each report, especially in regard to the exact definition of terms used. To decide what the term "city planning" includes, and whether some other term might be preferable, was one of the matters left to a joint committee of the two institutes.

Zoning in Canadian Acts

In regarding to zoning it was pointed out that in Canada most of the provinces have in force town planning acts which incidentally provide for zoning amongst other features dealing with the amenities of the areas affected.

At the Canadian Club luncheon there were not only the members of the American and Canadian planning institutes, but also many other engineers. Dean Mitchell, of the Faculty of Applied Science and Engineering, University of Toronto, who was the speaker and guest of honor, discussed the aesthetics of the war and the lessons to be drawn therefrom. He announced that civics and town planning are to be included in the science courses at the University of Toronto.

One of the features of the conference that aroused very favorable comment was the exhibit of housing and town planning schemes and data. The exhibit was entirely of Canadian material and was supplied by the office of the Dominion Housing and Town Planning Adviser and other federal and provincial government offices, individual Canadian engineeers and architects also having made contributions to the exhibit.

The importance of housing was frequently referred to throughout the conference. In his address of welcome, Hon. Mr. Rowell described housing conditions and the environment in which thousands are compelled to live in the larger cities of the American continent, as the great crime of the past. He urged the members to strive during the present reconstruction period to bring about a new and better social order.

The members of the institutes visited the sites of two housing projects of the Ottawa Housing Commission, and at "Lindenlea," Thomas Adams explained briefly the salient features of that project.

The progress of housing in the United States and in some of the provinces of Canada was commented upon by various authorities conversant with the subject, and last Saturday evening Thos. Adams showed moving pictures of housing projects carried out in England and Canada.

"The Planning of Ottawa" was treated by Noulan Cauchon, chairman of the Ottawa Branch of the Town Planning Institute of Canada, in a broad and entertaining manner. Mr. Cauchon's address ended what was unanimously declared to have been a very successful conference.

Following are the committee reports presented by Messrs. Olmsted, Knowles, Haldeman and Bassett:—

FUNDAMENTAL CONSIDERATIONS OF CITY PLANNING

By F. L. Olmsted

Chief Town Planner for the U. S. Department of Labor

THE purpose of this statement is to set forth certain fundamental considerations of city planning as an explanatory introduction to any specific conclusions which the American City Planning Institute may see fit to adopt in relation to special and limited questions within its field; largely to avoid the danger that such specific conclusions standing alone might give a mistaken impression of the scope of the subject and the attitude of the institute.

City planning, which in this statement is used broadly to cover the entire subject-matter, designated also by such terms as town planning and regional planning, is concerned with the territory occupied or to be occupied by any community and with prospective physical alterations in that territory and the objects upon it, in so far as such alterations can wisely be controlled or influenced by concerted action in the interest of the community as a social unit.

In theory no prospective physical alteration is so small, so localized, or so specialized in technique as to be excluded merely for that reason from the scope of city planning, provided it can wisely and effectively be controlled in the common interest. A problem of city planning may be wholly within the field of one of the many well-established specialized technical professions having to do with the physical surroundings of community life, or may concern several such fields, or may lie in a sort of no man's land, inadequately covered by any one of these professions.

The field is so wide and so complex that on the one hand effective progress in mastering it requires specializa-

tion, and makes it inevitable that much of the progress in technical knowledge and skill on which successful city planning depends will arise from the activities of innumerable specialized organizations, most of which concern themselves little with city planning as a whole, and that on the other hand it is necessary for any organization which deliberately addresses itself to city planning as a whole to concentrate as far as possible upon those aspects of the field which cannot be, or are not, effectively dealt with upon any narrower basis.

In theory there are no limitations to the extent of co-ordination desirable among the diverse planning activities which shape the physical growth of a community or to the extent to which it is desirable to estimate future contingencies and take account of them in planning; but practically there are very decided limitations upon the amount of time and effort which can be withdrawn from the vital business of getting things done for the sake of study and planning what to do and how best to do it.

The Most Fundamental Consideration

The most fundamental consideration of all in city planning, therefore, is to apply sound, clear penetrating common sense to the problem of how far it will pay to go, under any conditions, in forecasting the future and adapting present plans to future contingencies, and in suspending plans for meeting definite limited objectives of a local or specialized sort and modifying them for the sake of community purposes with which they are not directly concerned.

The classes in specific city planning problems which are most distinctively matters of city planning are:—

(a) Those in which the permanent interests of a community justify the modification of plans so as not merely to secure the immediate objects of a contemplated improvement, but also to fit the probable contingencies of a remoter future or to fit community needs which are only indirectly connected with the objects immediately in view.

(b) Those in which a close co-ordination of planning in two or more fields of technical work ordinarily segregated from each other in practice is likely, through avoidance of conflict and fuller utilization of joint opportunities, to secure advantages commensurate with the effort of obtaining the necessary co-ordination.

(c) Those which lie so much outside of the fields which are effectively covered by any specialized planning agencies that the community is likely to suffer from their neglect.

Merely to recognize problems of the above classes as they arise in the routine of community growth and to consider them from the broad standpoint of the community's general interests is city planning in a conservative or defensive sense. But constructive city planning requires also that many such problems, long before they become acute, shall be anticipated and considered under the impulse of imagination applied toward the attainment of the larger social objectives of the community.

Limited in Three Ways

Any one discussion of city planning must be limited in one or more of these ways: (1) It may be general and superficial; or (2) it may be confined to the problems of planning a limited area in a more or less complete and co-ordinated way, as for example, the planning of a residential subdivision, or of an industrial terminal district; or (3) it may deal with a limited class of problems in wider application as considered from the city planning standpoint, as for example, the planning of main thoroughfares or the distribution of schools and playgronds.

Almost any limited subject of discussion in city planning might be, so far as mere title is concerned, as appropriate for discussion in some other technical society as in the City Planning Institute, but such subjects will be discussed here always in their bearing on all the rest of city planning rather than in their bearing on the rest of highway engineering or of the educational system or other special technical field in which they happen to fall.

COST OF UTILITIES AND STREET IMPROVEMENTS AS AFFECTED BY THE SIZE OF RESIDENCE LOTS

By Morris Knowles
Consulting Engineer, Pittsburgh, Pa., and Windsor, Ont.

AT the outset it should be understood that there are other factors affecting the size at which lots should be designed, in addition to street improvements and utilities. It will be advantageous therefore to present a brief statement of these other various factors, in order that phases which are considered in this paper may be co-ordinated with them. Such factors are:—

1. Cost of land.
2. Size and arrangement of rooms in house.
3. Certain improvements that lie within the boundaries of the lot, such as grading (which is affected by topography), planting, fences, hedges and house walks.
4. Desirability of a front yard to properly set off house and to establish privacy from passers on street.
5. Desirability of a side yard to ensure sunshine, proper ventilation, adequate fire protection and suitable approach to rear.
6. Desirability of a rear yard to provide space for clothes line, house garden, garage perhaps, and playground for the children.

Elements Not Related

There are elements, even of street improvements and utilities, that in no way are related to size of lot. For example:—

(a) Those divisions of utilities that lie outside townsite boundaries, as water supply plant, both pumping station and filtration units; sewage treatment and disposal plants; power plant to generate electricity; steam plant, in event houses are to be heated from a central heating station; and in some cases a gas plant, though it may be doubtful whether such a plant would be erected.

(b) Various trunk supply lines which lead from the respective supply plants to townsite. These include water supply trunk line; gas and steam trunk lines; electrical transmission line; and sewer outfall line.

(c) There are certain portions of street improvements and utilities lying even within boundaries of townsite which are not directly and immediately affected by size of lot. For example, those street improvements and utilities that lie directly in front of house and that parallel the depth of house. These portions of utilities and street improvements are more affected by size and arrangement of house than by dimensions of lot. Likewise, there are certain elements of house connections which are not affected by size of lot; for example, conections to mains, curb-boxes, stop cocks, meters and the portions of house services that lie within the street.

The foregoing elements bear an important relation to the cost of utilities, in so far as they affect cost per capita or cost per house, but they are not in any way related to size of lot.

A well defined statement regarding those portions of utilities and street improvements which directly relate to size of lots can now be made.

(a) They include street improvements and utilities located directly in front of the space lying between houses.

(b) Street improvements and utilities located on minor streets that lie parallel to space occupied by front yards and by rear yards.

(c) Lengths of house service connections which are located in front yards and in rear yards.

Assumed Townsite

In order to estimate relative costs, it will be necessary to assume a town layout. Following are the factors:—

An industrial town with 1,000 houses. Houses are 22 ft. wide and 30 ft. deep. Lots are 42 ft. front by 80 ft. deep. Houses are located on center line of lots and are placed 15 ft. back from front property line. Main streets are 50 ft. wide; minor streets 40 ft. wide. Main streets have 24-ft.

(Concluded on page 409)

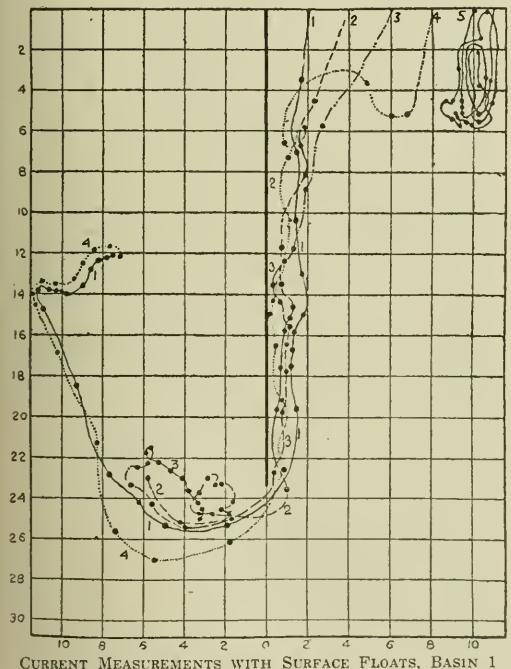
SOME OBSERVATIONS AND EXPERIENCES IN THE OPERATION OF COAGULATING BASINS*

By James Wadsworth Armstrong
Filtration Engineer, Water Works Department, Baltimore, Md.

THE two coagulating basins of the Montebello filters of the Baltimore water works are each 317 feet long, 232 feet wide and have an average depth of water of about 15 feet. A central baffle wall extends about three-quarters of the length of each basin. Water is admitted through five sluice gates, spaced at equal intervals, and, after passing around the baffle, is withdrawn through a similar number of gates. The water passes over a baffle at the entrance and over a skimming weir at the exit. It was the hope of the designer that the water would move with reasonable uniformity through the basins, but this has not been realized.

In the course of operation it was noticed that the movement of water through each of the two coagulating basins was different, although they were operated in parallel and apparently under the same conditions. It was also noticed that the water, while following characteristic lines in each basin, seemed to vary from time to time.

In order to learn something more definite regarding the exact movement of the water and its effect on the efficiency of the basins, a series of sixteen different current measurements was made. For making the observation, six identical

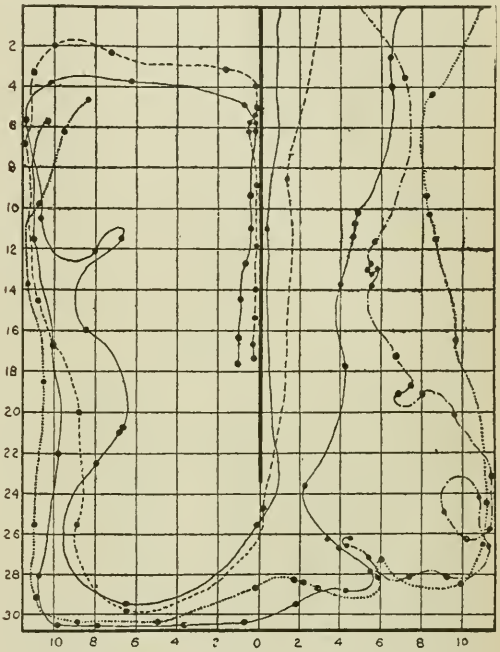


Current Measurements with Surface Floats, Basin 1

Readings of floats taken every five minutes; Venturi rate of flow, 123 m.g.d.; August 21st, 1917.

aluminum floats were used. Each float was cross-shaped in plan, and was composed of four sheets of aluminum, each 6 by 12 ins., inserted in a pine strip. The floats were just heavy enough to half submerge a large cork, to which a number was pinned. The portions of the floats exposed to the wind were very small, and, as the observations were not made on windy days, it is believed that their movements indicate the currents through the basin with reasonable accuracy. Most of the observations were made with the floats submerged just below the surface or 4 ft. below.

The floats were started at the entrance of the basin, and readings were taken, locating their position, every six minutes. The floats in the main channel, both surface and at the 4-ft. depth, generally moved forward at relatively high velocities, while those along the outer edges of the basin



Current Measurements with Surface Floats, Basin 2

Readings of floats taken every five minutes except first reading on each float, which had six minutes interval; Venturi rate of flow, 128 m.g.d.; August 14, 1917

moved in very erratic ways, sometimes getting caught in eddies in the corners and staying there for hours. Basin 1 usually showed an eddy at the entrance in the north-west corner, probably due in part to a slight difference in the alignment of the baffle. Basin 2 showed no eddies at the entrance, but both basins showed eddies in the far corners and usually along the outlet side of the baffle wall.

On August 14th, 1917, surface floats were used for making current measurements in Basin 1. The velocity of the floats varied considerably. Some of them moved *forward* at rates as high as 32 ft. per minute. On the outlet side of the baffle, two of them were carried *backward*, adjacent to the baffle, for three-quarters of its length. On August 18th, 1917, the basin was cleaned, and on August 21st other surface float measurements were made. On this occasion the floats moved along entirely different lines. One of them circled around in the north-west corner, the other four moved slowly along the baffle wall at velocities of from 2 to 12 ft. per minute, and on the outlet side of the baffle showed no decided forward movement.

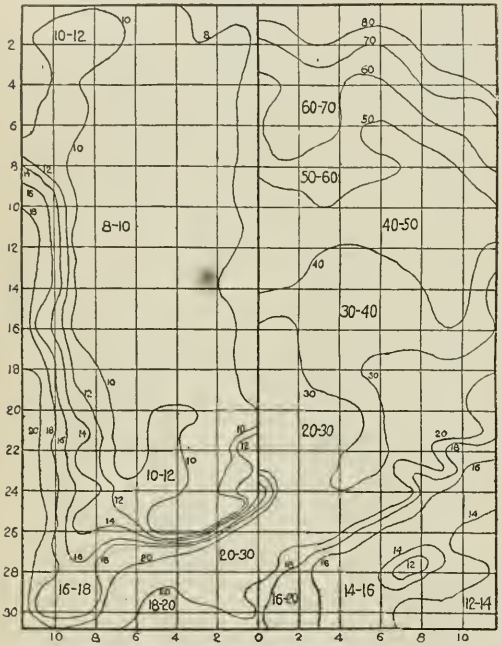
The greater velocity and more uniform movement of floats on August 14th was due to the fact that mud had filled the lower part of the basin, necessitating higher surface velocities. Most of the float measurements showed that higher velocities were obtained near the baffle wall on the incoming side and the outer wall on the outgoing side. A survey of the mud surface just before cleaning showed that the heaviest

*Paper presented to the American Water Works Association.

deposits followed approximately the lines of maximum velocity of flow, and that the greatest depth of deposit was at a point a little over 50 ft. from the entrance. The corners where eddies occurred had the least depth of mud.

On August 16th, 1917, two days before cleaning the basin, a turbidity survey of Basin 1 was made. Readings were taken at intervals of 10 ft. with a United States Geological Survey turbidity rod. The heaviest turbidities were observed at the entrance, and from there they decreased along pretty well defined but irregular lines toward the rear of the first half of the basin. In the second half of the basin the maximum turbidities followed approximately the lines of greatest velocity. This test seemed to indicate that the velocity at the entrance was too high to secure the best subsiding value, and that uniform velocities are necessary for uniform subsidence.

At one time, for a short period only, the bacterial counts were slightly higher in the effluent from the coagulating



Surface Turbidity Measurements, Basin 1

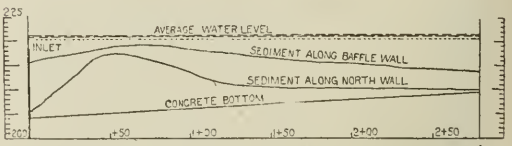
Readings taken with U. S. G. S. turbidity rod; Venturi rate of flow, 115 m.g.d.; August 16th, 1917

basins than in the raw water. The increase of growth in the basins led to the belief that bacteria were multiplying in the places where the currents were sluggish and were being gradually swept into the main current and carried to the filters.

In order to test the accuracy of this theory, several careful bacterial surveys were made. Numerous samples were taken at points showing the greatest difference of turbidity and velocity. One set was taken near the surface and another at a depth slightly above the mud line. The samples taken near the entrance of the basin showed slightly higher counts than those taken at other places, but none of the results showed any evidence of increased growth in any part of the basin.

In addition to the variations in velocity and the lack of uniformity in mud deposits, other irregularities were noticed in the functioning of the basins. As an illustration, it was noted on one occasion that Basin 1 gave decidedly better results than Basin 2, but upon making a slight change in the opening of one of the inlet gates, the condition was shortly reversed and Basin 2 gave markedly better results than Basin 1.

This phenomenon raised the question as to the possible effect of undercurrents upon the subsiding value of the basins. It was argued that if the elements of water in moving through the basin could be kept in nearly parallel



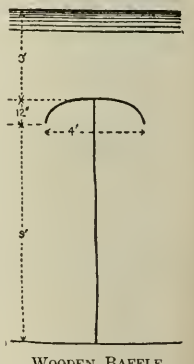
Sediment in Basin 1 on May 25th, 1916

lines, and if the movement could be confined to the surface of the water, leaving the lower stratum undisturbed, much greater subsiding value could be obtained.

With the purposes of testing out this theory, some modifications were made in the existing entrance baffle, and an additional cross-baffle was built in Basin 1. In order to give a positive outward sweep to the water entering the basin, increase the surface velocity and prevent returning undercurrents, a wooden apron about 2 ft. wide and sloping in an upward direction, was attached to the top of the existing entrance baffle. At the end of the existing concrete baffle, about 240 ft. from the entrance, an additional wooden baffle was built entirely across the basin. No changes were made at the outlet skimming weir. The new baffle was 10 ft. high and was capped with a top 4 ft. wide, which projected 2 ft. on each side. The top was curved downward at the ends in the form of a parabola. Water usually flowed about 3 ft. deep over the top of the baffle.

The following reasoning was responsible for the building of the unusual type of cross-baffle:—

The reduction of the cross-sectional area would tend to establish a more uniform flow across the top of the basin and create a quiet zone near the bottom that would permit better sedimentation. It was well known that when flowing water meets an obstruction, such as a baffle, there is a decided tendency to pick up sediment and carry it over the top, and it was argued from the known characteristic of a parabola to reflect rays of light in parallel lines that the sediment in the rising currents of water would, upon striking the parabola, be thrown downward and deposited, instead of being carried over into the next compartment. The curved top over the rear of the baffle is only useful in gradually reducing the velocity of water flowing over the top.



Wooden Baffle Across Basin 1

After this baffle had been in service for a number of months, the basin was cleaned. It was found that the apron extending across the top of the baffle at the entrance of the basin had been built a little too near the surface, and the velocity of entering water was so great that it carried most of the sediment outward as far as the cross-baffle. The results at the cross-baffle, however, were most gratifying. The parabolic top had evidently acted exactly as had been anticipated, for the mud was deposited adjacent to the baffle, almost to its full height, and sloped gradually backward to the entrance of the basin. The baffle on the return side had not performed so well, probably owing to the fact that the water in passing over it was not flowing in a direction normal to its face. It is believed that if this baffle had been placed about 70 ft. nearer the outlet it would have worked better.

As soon as the opportunity is afforded, the apron controlling the incoming water will be lowered so as to decrease the velocity at the entrance, and the baffle on the outgoing side will be removed forward. It is hoped that then the sediment will be deposited more uniformly.

This hopeful but imperfect experiment is made public with the thought that it may stimulate others to make further experiments or lead them to publish information which they already have.

COUNCIL OF THE ENGINEERING INSTITUTE SUPPORTS BILL CLASSIFYING CIVIL SERVICE

IT has been decided by the council of the Engineering Institute of Canada that it is advisable to support the bill, now before the Dominion parliament, relating to the reclassification of the civil service of Canada, at least to the extent that this bill affects the engineering profession.

This decision was reached despite considerable dissatisfaction with the proposed classifications and remunerations. It was feared that any concerted opposition to the bill would mean that it would not be passed in any form at all this session, and possibly not for many years.

Recommendations have been made to the Civil Service Commission by the deputy ministers of the various departments, and those recommendations have been taken into consideration, and many changes will be made in the bill as a result. Although it is not clear that the recommendations will be accepted in full, the necessary machinery has been provided for dealing with individual cases. An advisory board to the Civil Service Commission has been appointed, and it is understood that a board of appeal will be constituted, so that any decision of the Civil Service Commission (acting on the advice of the advisory board or upon representation made by a deputy) regarding any classification, may be appealed and reconsidered.

The proposed bill elevates the engineers employed by the government, giving them a certain status which they never previously had, and also in the majority of cases grants increased remuneration, and for these reasons it is now urged by the council of the Engineering Institute that the proposed bill be supported by engineers throughout Canada.

LIGNITE BRIQUETTES NEXT AUGUST

FINAL decision as to the location of the plant to manufacture briquettes from the lignite deposits in south-eastern Saskatchewan and south-western Manitoba will be made in the immediate future, states R. A. Ross, chairman of the lignite utilization board, which held its first session in western Canada two weeks ago in the Manitoba legislative chamber at Winnipeg.

Mr. Ross stated that the board would visit the lignite deposits and would discuss the matter of the location of the $400,000 plant. He said that it is the intention of the board to let all contracts for the construction and equipment of the plant during the coming winter, construction to commence as soon as possible, and if the plans of the board do not miscarry, the plant will be producing briquettes by August, 1920. The capacity of the plant will be 30,000 tons a year and briquettes will be sold to the coal dealers in Winnipeg at approximately $9.40 a ton.

The briquettes will be made from coal supplied by the mines now operating in the district and the board will probably pay $1 a ton for this very poor grade of lignite. If the lignite is not available from the mines, the board will undertake mining operations.

When asked by Hon. T. H. Johnson how the board would fill the demand for briquettes if the demand is in excess of the supply, Mr. Ross replied that that is a political question. Mr. Johnson afterwards explained that the point upon which he was seeking information is whether the board will make a fair distribution of the product, under such conditions, between Manitoba and Saskatchewan.

PRESSURES IN PENSTOCKS CAUSED BY THE GRADUAL CLOSING OF TURBINE GATES*

By Ford Kurtz
Muscle Shoals, Ala.

MR. GIBSON has made a valuable addition to the too few and scanty English treatises on the mathematical theory of water-hammer. His treatment of the subject, however, is chiefly of value in obtaining, without the use of differential equations and from physical laws the import of which is readily grasped, formulas which give the same practical results as the much simpler and less cumbersome equations of Lorenzo Alliévi, first published in Rome, in 1903. These equations must not be confused with the confessedly approximate and inadequate formula designated by Mr. Gibson as the "Alliévi formula," and on which R. D. Johnson has apparently founded a pressure-time equation. The equations referred to are mathematically rigid formulas which take into account not only the effect of net head but also the compressibility of the water and the extensibility of the pipe and which, so far as the writer knows, have never before been published in English. In 1911, the writer prepared, for his own use, a translation of a German translation of Mr. Alliévi's work, and found the latter's treatment so remarkably comprehensive and thorough that he has used it ever since in all water-hammer problems. The German translation† can be found in the Engineering Societies Library.

TABLE 1

Interval in terms of $\frac{2L}{a}$	$\phi(t)$	$\frac{F(t)}{H_0}$	$\frac{f_1(t)}{H_0} = \frac{F\left(t-\frac{2L}{a}\right)}{H_0}$	$z-1$	h_t, Allievi	h_t Gibson	Percent age of diver-gence.
0	1.00000	0.00000	.....	0.00000	0.00	0.00	.....
¼	0.95833	0.07338	.....	0.07338	12.10	12.12	0.16
½	0.91667	0.15476	.....	0.15476	25.53	25.53	0.00
¾	0.875	0.24503	.....	0.24503	40.43	40.41	0.05
1	0.83333	0.34550	0.00000	0.34550	57.01	56.96	0.09
¼	0.79167	0.43780	0.07338	0.42442	70.03	69.94	0.13
½	0.75	0.66286	0.15476	0.50810	83.84	83.72	0.14
¾	0.70833	0.84160	0.24503	0.59657	98.43	98.31	0.12
2	0.66667	1.03529	0.34550	0.68979	113.82	113.63	0.17
¼	0.625	1.26152	0.43780	0.76372	126.01	125.78	0.18
½	0.58333	1.50125	0.66286	0.83839	138.33	138.05	0.20
¾	0.54167	1.75454	0.84160	0.91294	150.64	150.32	0.21
3	0.5	2.02153	1.03529	0.98623	162.73	162.42	0.19
¼	0.45833	2.30592	1.26152	1.04440	172.33	171.97	0.21
½	0.41667	2.60955	1.50125	1.10830	181.28	181.10	0.15
¾	0.375	2.90456	1.75454	1.15002	189.75	189.43	0.17
4	0.33333	3.21686	2.02152	1.19534	197.23	196.77	0.23
¼	0.29167	3.53869	2.30592	1.23017	202.98	202.49	0.24
½	0.25	3.86010	2.60955	1.25055	207.83	207.14	0.33
¾	0.20833	4.18755	2.90456	1.28299	211.69	211.00	0.33
5	0.16667	4.51715	3.21686	1.30029	214.55	213.79	0.35
¼	0.125	4.84719	3.53869	1.31110	216.33	215.75	0.26
½	0.08333	6.17707	3.86010	1.31697	217.30	216.71	0.26
¾	0.04167	6.50630	4.18755	1.31875	217.59	216.95	0.28
6	0.00000	5.83293	4.51715	1.31578	217.10	216.57	0.23
Average percentage....							0.20

In presenting the exact formulas of Alliévi, the following nomenclature will be added to that of Mr. Gibson's paper:

$R_0 = aV_0/g$ = excess, or water-hammer, head due to instantaneous complete closure of gate.

$m = aV_0/gH_0$ = ratio of instantaneous water-hammer head to net head.

$F(t)$ and $f(t)$, or simply F and f = certain functions of time, t.

$z = (H_0+h_t)/H_0$ = ratio of total variable head to net head.

$\phi(t)$ = gate-opening at time, t, as a ratio of maximum gate-opening.

The exact formulas of Alliévi contain a term which makes it possible to determine the pressure at any point of the pipe line at any moment, but the writer is presenting only the simple form for determining pressure at the outlet,

*Discussion (presented to the American Society of Civil Engineers) of Norman R. Gibson's paper (see September 4th and 11th issues of *The Canadian Engineer*).

†"Allgemeine Theorie über die veränderliche Bewegung des Wassers in Leitungen," von Lorenzo Alliévi, 1909.

or discharge section just up stream from the gate, as that is the problem investigated by Mr. Gibson. It is also assumed that the pipe line is of uniform thickness and diameter throughout its length. Then, during the period,

$$0 < t \leq 2L/a,$$
$$z = 1 + F(t)/H_0,$$

where

$$F(t)/H_0 = m + \tfrac{1}{2}m^2[\phi(t)]^2 - m\phi(t)\{1 + m + \tfrac{1}{4}m^2[\phi(t)]^2\}^{1/2}.$$

and, during the period,

$$2L/a < t \leq T,$$
$$z = 1 + F(t)/H_0 - F(t - 2L/a)/H_0 = 1 + F(t)/H_0 - f(t)/H_0,$$

where

$$F(t)/H_0 = m - f(t)/H_0 + \tfrac{1}{2}m^2[\phi(t)]^2 - m\phi(t)\{1 + m - 2f(t)/H_0 + \tfrac{1}{4}m^2[\phi(t)]^2\}^{1/2}.$$

For the linear law of gate movement, $\phi(t) = 1 - t/T$, as already stated by Mr. Gibson.

These formulas applied to Mr. Gibson's first example give the following equations:—

For $0 < t \leq 0.35$ sec.,

$$F(t)/H_0 = 10.35008 + 53.56185\phi^2 - 10.35008\,(11.35008\phi^2 + 26.78092\phi^4)^{1/2}$$

and, for $0.35 < t \leq 6.0$ sec.,

$$F(t)/H_0 = 10.35008 - f(t)/H_0 + 53.56185\phi^2 - 10.35008\{[11.35008 - 2f(t)/H_0]\phi^2 + 26.78092\phi^4\}^{1/2}.$$

As already noted by Mr. Gibson, the values of $F(t)/H_0$ and $f(t)/H_0$ are so small compared with some of the individual terms of the equations, that it is necessary to use logarithms in solving the equations.

Using the exact Alliévi equations as given previously, Table 1 has been prepared, showing the rise of pressure and also the differences between the values of the rise obtained by Alliévi equations and those obtained by Mr. Gibson's equations. The maximum divergence of less than one-half of 1% shows the remarkable agreement of the two methods. It is apparent, however, that the simplicity of the solution by the Alliévi formulas, without giving heed to magnitude and direction of waves in the computations, makes it far superior to that of Mr. Gibson as a working method.

The exact formulas of Alliévi also furnish equations similar to those given previously for the case of the opening of a valve at the lower end of a pipe line, either from fully closed position, or from some initial partial opening. As already stated, in their complete form they also give the pressure at any time for any point along the pipe line, thus covering the matter mentioned by Mr. Gibson as to be discussed by O. V. Kruse.* Of course, there are also exact equations for the velocity at any time for any point along the pipe line.

The partial differential equations for the general motion of water in pipes are based on the fundamental differential formulas for the motion of water in general. Unfortunately, these partial differential equations, four in number, cannot be integrated (not even by approximate arithmetic integration so far as the writer knows) without making the following simplifying approximations:—

1. Velocity in direction of axis of pipe considered uniform over any chosen section of the stream.
2. Skin friction and viscosity neglected.
3. Velocities at right angles to the axis of the pipe, due to expansion or contraction of the pipe by changes in pressure, neglected.
4. Pressure considered uniform over any chosen section of the stream.
5. Assumed that the pipe consists of individual circular elements independent of each other, which are freely extensible.
6. Assumed that the ratio of velocity of water in the pipe to the velocity of propagation of pressure changes is small enough, compared with unity, so that its addition thereto or subtraction therefrom can be neglected in every case at every instant.

By making these approximations, we obtain the so-called exact formulas of Alliévi.

*See *The Canadian Engineer*, October 9th, 1919, p. 370.

Mr. Gibson's method of taking account of skin friction (which is only approximate, as has been pointed out by William P. Creager), could easily be applied to the exact Alliévi formulas by changing the factor m so as to have it correspond at all times to $(H_0 + ht)$ instead of to H_0.

The exact Alliévi formulas can be applied so as to take account of varying diameters and thicknesses of pipe in the same line, but they soon lead to so much complication that they become impracticable. In such cases, the writer uses the formulas as already given for a pipe of uniform diameter and thickness, but gives to m the value, $Q_0\Sigma(L/A)/gH_0\Sigma(L/a)$, where Q_0 equals the flow of water in a pipe at full gate-opening, L equals the length of any section of pipe, A, its cross-sectional area, and a, its individual value of the velocity of propagation of pressure changes. Also the factor, $2L/a$, must everywhere be changed to read $2\Sigma(L/a)$. This is confessedly an approximation made without mathematical proof, but it is probably exact enough for practical purposes in the majority of problems.

U. S. WATER POWER LEGISLATION

EFFORTS are being made by the engineers of the United States to obtain some measure of improvement in the water power legislation of that country. A circular letter has been drafted by the Water Conservation Committee of the U.S. Engineering Council and is being sent to every U.S. senator. The letter, which was signed by Alfred D. Flinn, secretary of the U.S. Engineering Council, is as follows:—

"Engineering Council asks your consideration of H.R. 3184, 66th Congress, 1st Session, which provides for the development of water powers in the navigable streams and on the public lands in the United States. This bill has passed the House of Representatives and is now before the Senate.

"During the past ten years, water power development in the United States on the public lands and in the navigable streams has languished. A certain small amount of development has taken place under conditions over which the Federal Government has no authority, but the best and most feasible development sites require Federal consent. Bills suitably providing for such consent have been under debate for a decade and the one above referred to (H.R. 3184) is approved by the heads of the several Federal departments concerned and also by the President. Advocates of legislation who have been on opposite sides of the water power question are generally agreed as to the merits of this bill and it is believed that it is the best measure that has yet been before Congress with any chance of passage. Probably, those who are now in disagreement after ten years of study and debate would be in the same position ten years hence. Therefore, it is bad public policy to wait longer; also, detrimental to the public interest and to industrial development.

"The importance of water power development in stimulating all kinds of industry, especially manufacturing, and the vital necessity of conserving and economizing our fuel supply, which, in turn, would largely relieve our congested transportation facilities, are so generally recognized that they need not be here emphasized.

"We, as engineers, are aware that the penalties that the country has already suffered by reason of the embargo on water power development, and would suffer from the consequences of further delay, are greater than those which could possibly be produced by all of the defects claimed against the bill by its few remaining opponents.

"We therefore hope you will lend your influence in favor of the speedy passage of the pending measure."

One can obtain a good conception of the remarkable growth of the American Association of Engineers during the last year when it is known that the number of paid employees at the national headquarters has grown in that time from four to sixty.

COST OF UTILITIES AND STREET IMPROVEMENTS

(Continued from page 404)

paved roadway, 5½-ft. planting strips, combined concrete gutters and curbs, and 5-ft. sidewalks. Alleys are omitted. There are 24 houses in each block, making length of block 504 ft. and width 160 ft. There are approximately 42 such blocks in the townsite. Filtration plant and pumping station is assumed, two miles from townsite; sewage disposal plant, one mile away; and electric transmission line and gas trunk line each three miles long. Assumed that it will not be necessary to build electric plant or gas plant.

TABLE 1—ESTIMATE OF ASSUMED TOWNSITE

Item	Cost Per House	Percent of Total Cost	Including Overhead
House	$3,000.00	54.85	64.0
Land	336.00	6.14	7.2
Lot improvements	232.64	4.25	4.9
Street improvements	463.29	8.48	9.9
Water system	190.15	3.48	4.1
Electrical system	26.33	0.48	.6
Gas system	101.18	1.85	2.1
Sewers—Storm and sanitary	202.48	3.70	4.3
House connections	138.50	2.53	2.9
	$4,690.57		
Engineering and supervision at 10%	469.06	8.58	
	$5,159.63		
Interest at 6%	309.58	5.66	
	$5,469.21	100.00	100.0

It will be noted house is 64% of total cost, including distribution of overhead; land with lot improvements, 12.1%; street improvements, 9.9%; water, electrical, gas and sewer improvements, with house connections, 14%. Engineering, supervision and interest charges, which are distributed in these statements, are 14.24% of the whole.

Figures shown in Table 2 are cost per lineal front foot of side yard and per lineal foot depth of front and rear yards. Costs per lineal foot lot frontage and depth would be greater, as cost of house meters, shut-off valves, etc., would be included in this cost.

TABLE 2—COST OF UTILITIES AND STREET IMPROVEMENTS PARALLEL TO YARD SPACE

	Cost for Length Parallel to 20-ft. Side Yard	Cost Per Lin. Front Foot of Side Yard	Cost for Length Parallel to 50-ft. Front and Rear Yard	Cost per Lin. Foot Depth of Front and Rear Yard
Street improvements	$178.60	$ 8.93	$ 55.00	$1.10
Water system	36.40	1.82	13.00	.26
Electrical system	4.20	.21	.00	.00
Gas system	17.40	.87	6.50	.13
Sewers — Storm and sanitary	54.00	2.70	17.00	.34
House connections	.00	.00	32.50	.65
	$290.60	$14.53	$124.00	$2.48

Results in Table 2 show that if space between houses on main streets is increased one foot, cost of utilities and street improvements per house is increased $14.53. If front or rear yard is increased one foot in depth, cost of street improvemnets and utilities per house is increased $2.48. These computations bring out the interest fact that in so far as street improvements and utilities are concerned, 5.86 ft. can be added to depth of front or rear yard for same cost of adding one foot to width of side yard.

Assuming for sake of comparison a lot 42 ft. front by 80 ft. deep, the combined cost of land and lot improvements is equal to $568.64, or $13.54 per front foot. (See Table 1). If, for this lot, costs of main and minor street improvements and utilities are combined and quoted as cost per lineal front foot of side yard parallel to yard space, they equal $20.73 per lineal foot.

If the cost of land and lot improvements be combined with cost of utilities and street improvements on main street parallel to side yard, the cost per lineal front foot of side yard is $28.07. Assuming rents based on 10% return, rent for each front foot of side yard is 23 cents per month, of which 12 cents is for street improvements and utilities, and 11 cents is for land and lot improvements. This is the cost of air and sunshine, or $4.60 per family per month.

While no sweeping conclusions can be made, because we have discussed only one assumed townsite, it is interesting to note that cost per lot for "street improvements and utilities" is $1,121.93, compared with $568.64 for "land and lot improvements," the latter being 50% of former. If however, we compare cost per front foot of those elements of street improvements and utilities directly related to size of lot, with cost per front foot of lot improvements and land, they are respectively $20.73 and $13.54, the latter being 65% of the former.

Some Suggestions

Following are some suggestions on economical design and construction:—

Use contour streets.

Grade lots and streets at same time.

Design street widths and pavements to meet demands of traffic.

Compare cost of reducing grades with cost of pavements suitable for steeper grades.

Do not make sidewalks unnecessarily wide.

Use combined gutter and curb.

Study relative merits of alleys and easements.

Study carefully location of utilities.

Use combined trenches where suitable.

Substitute direct sewer connections for catch basins.

Use combination manholes.

Connect roof leaders to gutters.

Omit storm sewers near summits of streets.

Install house connections at one time.

Carry house wire services on brackets attached to rear of house.

RULES OF PRACTICE FOR THE ESTABLISHMENT OF STREET WIDTHS AND THEIR SUBDIVISIONS

By B. A. Haldeman
Advisory Engineer, Zoning Commission, Philadelphia, Pa.

STREETS should be divided into the following four classes, based upon their immediate and future purpose and service: Main, secondary, minor and special service streets.

Main streets will form the principal routes for the immediate or future use of large volumes of mixed traffic moving between important centres within a community or from community to community.

Secondary streets will be those of lesser traffic importance, supplementing the main streets and serving to distribute mixed traffic to and from the latter and between centres of lesser importance.

Minor streets will be those laid out for purely local traffic use or to facilitate the subdivision or development of property.

Special service streets will be those designed and laid out for special purposes and restricted to special uses.

The General System

The location, width and subdivision, and also the grade, of main and secondary streets should be based upon their present and future value as traffic carriers. They will form the primary net of the street system and should be planned in advance of urban improvements as the controlling elements in the general development of the transportation and other circulatory facilities of the city and the adjacent region, and consideration should be had in their layout for the economic development of those facilities. At least a primary scheme of zoning for use should precede or accompany their layout.

Certain types of special service streets, particularly those designed to connect the units of a park system, should be laid out coincident with the traffic net.

With the net of main and secondary streets established, the areas lying between them may be subdivided by such system of minor or special service streets as may best serve the development of each particular area.

Street Widths

The width of a street shall be understood in all cases to mean the distance between the bounding property lines.

The width of main and secondary streets should be such as will adequately accommodate such classes and such volumes of traffic as are likely to be put upon them after the territory or region they serve shall be fully developed.

The width of minor streets should be such as will adequately care for local travel and service of abutting property.

As special service streets will be designed to serve special and particular uses, any attempt to standardize their widths would be futile.

Recommended widths are as follows:—

Main streets	108, 128 or 148 ft.
Secondary streets	60 or 80 ft.
Minor streets	12, 20, 40 or 50 ft.
Special service streets	Variable.

In cities and regions where the laying out of any considerable number of streets of a greater width than 80 ft. would be unwise, it is recommended that streets exceeding that width be placed in the special service class, the "secondary streets" classification eliminated, and the 60 and 80 ft. wide ones classed as "main streets."

Cross-Section Subdivisions

The unit width for a line of vehicles shall be 8 ft.

The unit width for a line of pedestrians shall be 2 ft.

The so-called "elastic" method should be employed in establishing and increasing the widths of subdivisions.

The roadway width of a street shall be the distance between curb lines, or between the centres of the gutters where there are no curbs.

No roadway for a single line of vehicles should be less than 8 ft. or more than 10 ft. wide.

Roadways to accommodate two lines of vehicles should be 20 ft. wide except that such roadways in minor and special service streets may be 16 or 18 ft. wide.

Roadways to accommodate three lines of vehicles should be 26 ft. wide.

Roadways to accommodate four lines of vehicles should be 36 ft. wide.

Any increase beyond a roadway width of 36 ft. should be made by adding an 8-ft. unit for each additional line of vehicles to be accommodated. Where the street is, or will be, occupied by street railway tracks, the unit should be undivided, but where there will be no tracks, the unit may be divided.

The minimum width of the space between the property line and the curb line, including width of the curb, should be as follows:—

On streets 40 ft. wide	11 ft.
On streets 50 or 60 ft. wide	12 ft.
On streets 80 ft. wide	14 ft.
On streets more than 80 ft. wide	18 ft.

Sidewalks and Planting Strips

The width of the paved footway on any street should not be less than 4 ft. Increases beyond that width should be by 2-ft. units or multiples thereof.

The planting strip between the property line and the nearest edge of the paved footway should not be less than 1 ft. wide on a 40-ft. wide street, or less than 2 ft. on a street of greater width.

The width of the planting strip between the curb line and the nearest edge of the paved footway, including the width of the curb, should in no event be less than 4 ft. in a street 60 ft. or less in width, or less than 6 ft., in a street of greater width than 60 ft.

Trees should be planted in such locations that they will not be disturbed by, or obstruct, any subsequent change in the curbs or paving.

Where dual roadways are laid, separated by a planting strip, the latter may be of variable width and the curbs adjacent to the sidewalk should be set in their permanent locations.

Where a central reservation for street railway tracks is established it should be at least 20 ft. wide.

The following are suggested typical widths and arrangements of cross-section subdivisions. (Figures indicate widths in feet):—

	40-ft. Streets.			50-ft. Streets.		
	(*a*)	(*b*)	(*c*)	(*a*)	(*b*)	(*c*)
Planting strip	1	1	1	2	2	2
Paved footway	4	6	4	4	4	6
Planting strip	6	4	5	9	6	4
Roadway	18	18	20	20	26	26
Planting strip	6	4	5	9	6	4
Paved footway	4	6	4	4	4	6
Planting strip	1	1	1	2	2	2
	40	40	40	50	50	50

	60-ft. Streets.			80-ft. Streets.		
	(*a*)	(*b*)	(*c*)	(*a*)	(*b*)	(*c*)
Planting strip	2	2	2	2	2	2
Paved footway	4	4	6	4	6	6
Planting strip	14	11	4	21	14	6
Roadway	20	26	36	26	36	52
Planting strip	14	11	4	21	14	6
Paved footway	4	4	6	4	6	6
Planting strip	2	2	2	2	2	2
	60	60	60	80	80	80

	108-ft. Streets.			128-ft. Streets.			148-ft. Streets.			
	(*a*)	(*b*)	(*c*)	(*a*)	(*b*)	(*c*)	(*a*)	(*b*)	(*c*)	(*d*)
Planting strip	6	4	2	6	4	2	6	4	2	2
Paved footway	4	6	8	4	6	8	4	6	8	8
Planting strip	8	8	8	8	8	8	8	8	8	8
Roadway	20	26	26	20	26	36	20	26	36	44
Reservation	32	20	20	52	40	20	72	60	40	24
Roadway	20	26	26	20	26	36	20	26	36	44
Planting strip	8	8	8	8	8	8	8	8	8	8
Paved footway	4	6	8	4	6	8	4	6	8	8
Planting strip	6	4	2	6	4	2	6	4	2	2
	108	108	108	128	128	128	148	148	148	148

ZONING

By Edward M. Bassett
Chairman, Zoning Committee, New York City

THE subject should be called building zoning, the boards zoning boards or commissions. In laws and ordinances, the word "zoning" should be used in the title and the word "districts" in the body of the law to specify the areas affected. The word "zoning" is sufficient when city planning is under discussion.

Zoning is the creation by law of districts in which regulations differing in different districts prohibit injurious or unsuitable buildings and uses.

Zoning should be done under the police power of the state and not by condemnation.

Before attempting zoning, a city should obtain the power to do so from the state legislature. The essential statement in such donation of power is that the city may impose different regulations for buildings and for the uses of land and buildings in different districts.

Enhancement of value alone, or aesthetics alone, is not a proper basis for zoning when done under the police power.

Zoning is part of the city plan and should be applied to land at least as early as the street layout is adopted.

Zoning when applied originally to existing cities should be adapted largely to existing facts and normal tendencies.

In the same city, localities having substantially a like character and situation should be zoned in the same manner. This principle should prevent preliminary, emergency, piecemeal or partial zoning.

Zoning should be sufficiently permanent to protect those who comply with the law, but at the same time should be susceptible of change by the municipal legislature under strict checks, so that it can be altered to harmonize with the city's growth.

Provision should be made that property owners may initiate changes or restrict the freedom of the municipal legislature to make specific changes, but the actual application of the zoning regulations to the land, and any changes therein should rest with the municipal legislature and not with the property owners.

Zoning regulations may properly be supplemented by restrictions in deeds based upon purely aesthetic reasons or for the purpose of creating a uniform residential development.

Outside of Zoning's Scope

Regulations applicable to all buildings of a class, regardless of location, such as relate to plumbing, strength of material, safety devices, or protection of employees against fire, should not be placed in a zoning law. They are properly part of a housing law, factory law or building law. Only those requirements which differ in different districts enter into a zoning law.

Zoning by the exercise of the police power of the state must relate to the health, safety, morals and general public convenience of the community. It follows, therefore, that police power zoning must be confined to police power reasons such as fire risk, lack of light and air, congested living quarters and disease-promoting conditions. The preventive regulations based on these reasons, which necessarily must be applied differently and in different measure in different districts, naturally group themselves into zoning according to use, according to height of buildings, and according to bulk, arrangement or area of lot covered by buildings. Zoning could properly go further and embrace building material requirements, commonly called fire limits, fireproof construction, uniform setbacks and doubtless other classes of regulations.

Use districts are residence, business, light industry and heavy industry. Use districts should be few. The more minute adaptation to local needs should be provided for in the area and height zoning, and by permitting special uses under conditions stated in the ordinance or under the administration of a board of building exceptions. Districts described as one-family, two-family, attached house or apartment house, have no intimate relation to the police power and are apt to invite criticism by the courts.

Pressure on Non-Conforming Structures

Where zoning regulations apply only to new buildings (as is the safer practice), non-conforming uses should be placed under a constantly pressing incentive to become conforming through time and changes.

(a) The structural alterations made in a non-conforming building should in no case exceed one-half its value, nor should the building be enlarged, unless its use is changed to a conforming use.

(b) In a residence district, no building or premises devoted to a use permitted in a business district should be changed into a use excluded from a business district.

(c) In a residence or business district, no building or premises devoted to a use permitted in a light industry district should be changed into a use excluded from a light industry district.

(d) In a residence, business or light industry district, no building devoted to a use excluded from a light industry district should be structurally altered if its use shall have been changed since the time of the passage of the ordinance to another use also excluded from a light industry district.

(e) In a residence, business or light industry district, no building devoted to a use excluded from a light industry district should have its use changed to another use which is also excluded from a light industry district if the building has been structurally altered since the time of the passage of the ordinance.

In business and industry districts, towers without limit as to height should be allowed to occupy not over one-quarter of the lot area and they should be allowed on the street line all the way up. They should, however, stand away from side lines according to a suitable rule.

Height limitations should have a relation to street widths. A city, which has no buildings over 150 ft. in height, should allow none over that height.

Included in area limitations, there should be a limitation of families per acre extending from 140 families in the most thickly populated districts to 18 in parts of the suburbs. This regulation should also refer to the arrangement of the buildings and their adaptation for housekeeping units.

An administrative board should have power (a) to rectify on appeals the mistakes of building superintendents in passing on applications for permits; (b) to decide borderline and exceptional cases where specified in the ordinance; (c) to vary the literal requirement of the law where unnecessary hardship is caused and the intention of the law may be equally accomplished by an alternative method to be prescribed.

Not only should the powers of such a board be specified in the ordinance, but the state legislature should authorize the local legislature to create such a board and to delegate powers to it in the ordinance. It is prudent to have the ordinance prescribe a rule of conduct for such a board, as for instance that where unnecessary hardship is caused by the strict adherence to the ordinance, the board may vary the requirement in order to carry out the general purpose of the law in an equally safe or sanitary manner.

CONCRETING IN COLD WEATHER OFFERS STRONG ADVANTAGES TO OWNERS

By A. E. Wells
President, Wells Bros. Construction Co. of Canada, Ltd.

ON the verge of winter; construction blocked in hundreds of cities; a shortage of many materials of construction and of labor; and yet withal, an acute shortage of homes, offices, stores and—in many cities—of office buildings, factories and warehouses,—what is the answer?

The answer lies in winter construction, in proceeding with work during December, January and February, which have been normally "closed" months. Winter work is not new. It has been practised for years, its safety adequately demonstrated, its economy proved. It should be more generally practised.

Any owner who, through prosecuting work during cold weather, can get occupancy of factory or warehouse, or can lease apartments, offices or store space on May 1st, stands to gain far more than the added costs of winter work.

Not only the owner, but builder, engineer and architect, gain. There is financial loss to the contractor who breaks up his trained organization, only to build it again in the spring. New men must take time to accustom themselves to working together and owners pay the bill in increased costs. Architects' and engineers' offices are frequently idle through much of the winter. Building superintendents have nothing to do and owners pay for unproductive overhead.

Perhaps the best way, then, to reduce the cost of building is to keep architects', engineers' and contractors' forces busy twelve months of the year.

Why Does Construction Stop?

Primarily the reason why building has been inactive in winter is that concrete does not harden so rapidly when its temperature hovers near freezing. But we heat our homes, offices and stores, and coal is a comparatively small operating cost. We are to-day able to enclose a structure, warm it with simple coke stoves, heat aggregates prior to mixing with Portland cement, and keep the concrete or mortar warm until hardening has occurred.

Without these precautions, cold weather work is impossible but the precautions are simple and reasonably inexpensive. Why not do the logical thing and consider the winter as an open season for all but the most exposed class of construction?

Our organization has continued to lay brick and place concrete under zero temperatures in Canada. A part of our normal equipment is sufficient tarpaulins to enclose practically any structure and sufficient salamanders or coke stoves to keep such enclosures warm. Boilers of any type, frequently those used to furnish steam for hoisting, supply live steam for heating aggregates and water, and for thawing snow and ice from forms and reinforcing steel.

While a heavy snow may temporarily delay the delivery of materials, yet deep snow is seldom encountered. It is temperature alone that commonly hampers work, and temperature need not be feared.

Plant Layout for Winter

In laying out a plant for handling concrete in winter, or where the work is likely to run on into winter before completion, there must be provision for the proper heating of materials and water. In case of sand and gravel in open storage piles, it is only necessary to lay a grid of steam pipes under the material piles and place a tarpaulin over the pile. From one main through the centre, branches should extend in both directions every 6 ft. These branches should be drilled with ⅛-in. holes spaced about 18 ins. apart. Several hundred yards of material stored in one pile can be heated in this way with the steam from an ordinary hoisting boiler. Several days prior to concreting, steam should be turned into the pile during working hours, which will be sufficient, except at times of extreme cold, to maintain the necessary temperature.

When material is stored in bins, a series of pipes should be laid on the floor of the bins, feeding from a main pipe at the top of the sloping floor. Steam radiates through the entire contents of the bin and if a canvas cover is pulled over the top when work is stopped at night, the material will retain its heat except in very cold weather, when a small amount of steam may be needed at night.

It is necessary also to heat mixing water, and a steam line running directly into the water tank is the customary way; a 1-in. line being sufficient to heat water for a 1-yd. mixer.

But concrete poured into forms exposed to cold would lose its heat before hardening had progressed sufficiently. Forms must, therefore, be protected and the most satisfactory means is a complete canvas enclosure, with salamanders or coke stoves to maintain a temperature of 45 degs., or over, within. Several hours before concrete is poured, salamanders are started in the story below the forms, unless that story is already heated. Immediately after pouring, a sufficient number of salamanders are placed above the new concrete to ensure its safe and thorough hardening. These will furnish heat for the floor above.

This method of enclosure and heating necessitates that the form work for the floor above that being poured shall be in place, in order to serve as a roof under which concrete may be kept warm; although in the case of steel frame structure, it may be possible to support canvas upon the steel because of the floor above.

Posts Set Upon Blocks

Forms for the story above are supported as usual, upon posts, but since the floor slab of the story supporting these posts is not yet poured, it is customary to set the posts upon concrete blocks of the proper depth, so that upon pouring, the block becomes a part of the finished floor. This requires setting blocks to grade and finishing their upper surface.

It is, of course, necessary that the workmen be watched somewhat more carefully on winter work. Snow or ice in the forms is detrimental to good work. Careful inspection is necessary at every stage of the work, but slipshod methods are probably no more likely to affect quality in winter than in summer.

Where the enclosure in canvas is comparatively complete, workers operate at practically normal efficiency, but there are some delays likely to occur through slow delivery of materials during periods of snow. Yet the added costs are more than compensated for by the certainty of quicker occupancy and reduction of interest on money tied up in the incompleted building. It would seem folly to cease work on a structure where there is need of early use.

FEDERAL CEMENT CO., OWEN SOUND

PUBLIC offering will soon be made of $1,000,000 six per cent. first mortgage bonds of the Federal Cement Co., which will operate at Owen Sound, Ont., it is said, but which is incorporated under the laws of the State of Delaware. This issue, it is understood, will be offered to the public at par and interest, with a bonus of 50% of common stock, by a Chicago financial concern.

The officers of the Federal Cement Co. are: J. G. Lind, vice-president of the St. Mary's Cement Co., president; J. E. Murphy, vice-president of the Vancouver Portland Cement Co., vice-president; J. E. Campbell, secretary-treasurer of the Hepworth Mfg. Co., Hepworth, treasurer; A. D. Creasor, of Owen Sound, secretary; with whom L. N. Rosenbaum, president of the Knickerbocker-Wyoming Oil Co., New York, will constitute the board of directors.

The Federal Cement Co. has contracted to acquire the plants formerly operated by the Union Cement Co. and the Imperial Cement Co. at Owen Sound, it is stated, and plans to remodel them to a capacity of 2,000 barrels daily.

$500,000 RESERVOIR FOR WINNIPEG

NOW that the $15,000,000 water scheme for Greater Winnipeg has been brought to a successful conclusion, that city must at once plan for a reserve supply in case of breakdown in any portion of the 100-mile aqueduct between Winnipeg and Shoal Lake, according to an official report which W. G. Chace, chief engineer, has submitted to the Greater Winnipeg Water Board.

This reserve has been figured on before and from time to time discussion upon it has been allowed to drop. Now, however, Mr. Chace says that the time has come for the board to authorize preparation of the plans, with the idea of completing the whole undertaking next summer. Along with the under-drainage, which experts have agreed is necessary, there will be considerable work to be carried out near Deacon as soon as the frost is out of the ground next year.

This reserve plan is a part of the original scheme as recommended in 1913 by the consulting engineers, Rudolph Hering, F. P. Stearns and J. H. Fuertes.

Deacon, about ten miles from Winnipeg, is where the reservoir will be built. It will have a capacity of 250,000,000 gallons, or, on present needs, a reserve supply sufficient to last 20 days.

The cost of the reservoir is estimated at approximately $500,000.

"Winnipeg and district have now the finest water supply anywhere on the North American continent," says Mr. Chace. "But Winnipeg will need a large reserve to be at all safe. If anything should happen to the aqueduct, we would be up against it within two days."

Asked if the city could not go back to the well system in case of emergency, Mr. Chace replied that the reservoir at Deacon has to be constructed sooner or later and the district might just as well do it next year as at any other time. Its maintenance cost would be negligible after construction, he says. Moreover, the wells formerly used could not be placed in shape again without a heavy expenditure, leaving out of consideration the disadvantage of again having to use hard water.

"This will be one of the best opportunities to provide work next summer that the city and district could wish for," says Mr. Chace.

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QUEBEC MUNICIPALITIES' ENGINEERING BUREAU

ENGINEERS in private practice are viewing with alarm the growing tendency of governments and public commissions to offer "free" or "at cost" engineering services. The latest addition to the official or semi-official bureaus of engineering information—or, as sometimes happens, misinformation—is in connection with the new Union of Quebec Municipalities, which is to be launched at a meeting in Montreal toward the end of next month or early in December.

At a meeting held last month, thirty Quebec mayors or their representatives attended and appointed a committee to draw up a constitution and operating program. The plan of the association has now been prepared and is to be submitted at next month's meeting, to which twelve hundred Quebec municipal officials will be invited. In commenting upon the new Union, the Montreal Gazette says:—

"One feature of the Union, the constitution of which is drafted after those of the sister provinces, is the creation of a special bureau of consultation for all legal, engineering and accounting matters pertaining to municipalities, a feature which is an improvement on all the existing provincial unions."

The advantages of an engineering bureau of the sort proposed for the Union of Quebec Municipalities, are dubious. Assuming that the appointments to the staff of the bureau are kept out of politics, and that the men selected are very capable engineers of high integrity and great capacity for work, the experiment is still doubtful. Any employe of such a bureau tends to get into certain grooves of practice and to develop "hobbies." All work is standardized along certain lines of established practice and there is likely to be extreme reluctance to adopt new ideas. The municipalities are deprived of the competition of brains and skill that results from the employment of individual engineers or those in private practice. Unless the head of the bureau is also practically the head of his profession, the municipalities are debarred from obtaining the best advice that could be obtained from independent consultations. The head of the bureau may be somewhat in the same position as the "company doctor" in a mining community. Most of the miners prefer to hire their own doctor.

POWER IN BRITISH COLUMBIA

IN British Columbia there is said to be a surplus of developed hydro-electric power. The Vancouver Island Power Co., the Vancouver Power Co., the Western Canada Power Co., and the West Kootenay Power and Light Co., all have considerable power now available, the utilization of which is highly desirable from the standpoint of the capital invested in these companies. A recent suggestion by the "Mining and Engineering Record," of British Columbia, that Commissioner Retallack, who now has charge of the Public Utilities Department of the British Columbia government, should assist these companies in disposing of this power, is a reasonable suggestion and entirely in the interest of industry and employment in the Pacific province.

REPORT ON ST. LAWRENCE RIVER

SIR ADAM BECK, chairman of the Hydro-Electric Power Commission of Ontario, states that the report on the location of the dams for the St. Lawrence river power development, at present in course of preparation, will likely be completed within two or three months. He made this statement when interviewed in reference to the possibility of Toronto and all the large ports along the Great Lakes becoming "ocean ports" in consequence of the St. Lawrence power development, as pictured by Franklin K. Lane, U.S. Secretary of the Interior.

The building of the proposed dams at Morrisburg and the Long Sault raises the water level to accommodate boats of from 25 to 30 ft. draft. Sir Adam pointed out that Ontario would have 1,684 miles bordering on the Great Lakes and rivers, which would, as Mr. Lane says, take care of ocean-going traffic.

"The dam at Morrisburg," he continued, "will regulate the levels of Lake Ontario and create a storage system and largely eliminate floods on the St. Lawrence. It will also create a storage sufficient to make available 20,000 sec. ft. during the periods of the year when the water is low, and will raise the level of the harbor of Montreal from two to three feet.

"We have had engineers working on the St. Lawrence for the past three years, and hope to have the final report on the work in the course of three months, fixing the location of the two dams. That will be most desirable from the standpoint of navigation, and will create 2,000,000 h.p. of electricity, 1,000,000 for the United States and 1,000,000 for Ontario."

LARGE IMPORTS AND EXPORTS

WITH but one-fifteenth the population of the United States, Canada does one-fifth the amount of trade. This statement is based upon official figures just published showing the total of U. S. trade for the year ending August 31st. The comparison is made on the assumption that there are about 8 million people in Canada and 120 million in the United States. The report shows that the U. S. exports for the year totalled $7,415,000,000. Canada's $1,233,000,000, a proportion of one-sixth. Their imports were $3,233,000,000, ours $870,000,000, a proportion of one-fourth. Their total trade was $10,648,000,000, ours $2,103,000,000, a proportion of one-fifth.

PERSONALS

NORMAN McLEOD RAMSAY WILSON, inspector and water works engineer of the Canadian Fire Underwriters' Association, Toronto, has resigned in order to become chief engineer of the Brantford, Ont., water works. Mr. Wilson was born December 3rd, 1869, in Bombay, India. He was educated in England at the Paradise House School and the City and Guilds Technical College, London, where he studied mechanical engineering. Upon leaving college in 1885, he was articled to Richard Johnson, chief engineer of the Great Northern Railway, with whom he spent five years in general railway engineering. Upon leaving the Great Northern, Mr. Wilson spent two years in construction work with Lucas & Aird, contractors, who were then constructing the West Highland Railway, Scotland.

For the following six years he was assistant engineer of the Northeastern Railway, engaged in maintenance and construction of railway and docks. In 1898, Mr. Wilson was appointed assistant county surveyor for the North Riding of Yorkshire, where he spent three years on the design and construction of roads, bridges and public buildings, principally roads. In 1901 he was appointed resident engineer in charge of construction of the Dearne Valley Railway, a colliery line in South Yorkshire, now part of the Lancashire & Yorkshire Railway. In this position Mr. Wilson had further experience in both design and construction, and represented the railway throughout until the contractors turned the road over to the owners, after which he came to Canada in 1907, and secured a position with the bridge department of the Canadian Pacific Railway as resident engineer on the construction of the superstructure of steel bridges, chiefly in New Brunswick. In 1909, Mr. Wilson's services were secured by the Canadian Fire Underwriters' Association, by whom he has been employed continuously for the past ten years. His work with that association has consisted of inspection of water works plants throughout Ontario and the making of recommendations for the improvement of plants from a fire protection standpoint. Mr. Wilson reported upon and kept in touch with the water works and fire protection systems of 212 municipalities in Ontario and also a number in British Columbia. He compiled detailed records of the equipment possessed by every municipality, and also prepared plans of every municipality, showing the location of mains, hydrants, pumping stations, reservoirs, etc. At Brantford Mr. Wilson will be in charge of the proposed extensions to, and reconstruction of, the water works system, and in this work he will have the co-operation of R. S. & W. S. Lea, consulting engineers, Montreal, who have been engaged by the city council to advise regarding methods of increasing the present supply. Mr. Wilson has been a member of the Institution of Civil Engineers of Great Britain for more than 25 years.

SIR ALEXANDER BERTRAM has been appointed treasurer of the Engineering Institute of Canada, to succeed the late Ernest Marceau.

L. R. BROWN, formerly engineer and superintendent of the Toronto Chemical Co., Sault Ste. Marie, Ont., has accepted the position of road engineer with the Dominion Tar & Chemical Co.

DR. F. D. ADAMS, Dean of the Faculty of Applied Science, McGill University, is acting as head of that university until the new principal, Sir Eric Geddes, is free to resume the duties of his office.

ROY A. SPENCER, who served overseas as major of the 3rd Divisional Canadian Engineers, and who returned to Canada two months ago, has been appointed professor of engineering at Dalhousie University, Halifax, N.S.

R. S. L. WILSON is now the official head of the Faculty of Engineering at the University of Alberta, succeeding the late Prof. Muir Edwards. Mr. Wilson's appointment was recently confirmed by the president of the university. Prof. Wilson was formerly a designing engineer on the Welland Canal staff, having previously been a general contractor in Saskatchewan. Recently he has been associated with McGill University and has also acted as consulting engineer for a contracting firm in Montreal.

OBITUARIES

JAMES LOW, a prominent contractor of Ottawa, Ont., fell into the Rideau Canal two weeks ago and was drowned.

BARRY SMITH, resident engineer for the Dominion Construction Co., Toronto, on concrete construction in the Parry Sound District for the C. N. R., was fatally burned in the conductor's van of a construction train when the train was wrecked.

DUNCAN McD. CAMPBELL, of Halifax, engineer on the staff of the Nova Scotia Highway Board, died last week at his home. Mr. Campbell had been in ill-health for nearly a year. He was a native of Truro, N.S. Previous to his appointment two years ago to the staff of the highway board, he was assistant city engineer of Halifax.

R. A. ROSS TO BE E. I. C. PRESIDENT

FOR the year 1920, the president of the Engineering Institute of Canada will be R. A. Ross, city commissioner of Montreal, and chairman of the Lignite Utilization Board of Canada. Prior to his acceptance last year of the city commissionership, Mr. Ross was a prominent consulting civil and electrical engineer.

The report of the nominating committee has been received by the council of the institute. As usual, the president is chosen by acclamation. For all other offices, twice as many men are nominated as are to be elected. The nominations for vice-presidents are:—W. G. Chace, Winnipeg; A. S. Dawson, Calgary; C. H. Mitchell, Toronto; John Murphy, Ottawa.

Following are the nominations for councillors:—District No. 1—F. B. Brown (Montreal), J. Duchastel (Montreal), V. I. Smart (Montreal), and Julian C. Smith (Montreal); District No. 2—F. T. Cole (Quebec), and A. R. Decary (Quebec); District No. 3—F. A. Bowman (Halifax), and W. P. Morrison (Halifax); District No. 4—J. B. Challies (Ottawa), and Alex. Macphail (Ottawa); District No. 5—R. K. Palmer (Hamilton), and E. R. Gray (Hamilton); District No. 6 for one-year term—W. J. Dick (Winnipeg), and B. S. McKenzie (Winnipeg); District No. 6 for a two-year term—Guy C. Dunn (Winnipeg), and J. M. Leamy (Winnipeg; District No. 7—J. R. C. Macredie (Moose Jaw), and C. P. Richards (Regina); District No. 8—G. W. Craig (Calgary), and F. H. Peters (Calgary); District No. 9—H. M. Burwell (Vancouver), and C. Brakenridge (Vancouver).

G. D. Mackie, city engineer and commissioner of Moose Jaw, Sask., has been upheld by the city council in his refusal to permit one of his assistants to make a written report directly to the mayor, although the members of the city council intimate that they think it may be quite in order for the mayor to seek verbal information from any members of Mr. Mackie's department.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand or proposed, contracts awarded, changes in staffs, etc.

ADDITIONAL TENDERS PENDING

Not Including Those Reported in This Issue

Further information may be had from the issues of *The Canadian Engineer*, to which reference is made.

PLACE OF WORK	TENDERS CLOSE	ISSUE OF	PAGE
London, Ont., street flusher	Oct. 27.	Oct. 16.	46
Pointe aux Trembles, Que., repairs to landing pier	Nov. 5.	Oct. 16.	54
Rimouski, Que., monument	Oct. 30.	Sept. 25.	52
St. Clements, B.C., bridge	Nov. 19.	Oct. 16.	48
St. François Sud, Que., wharf	Nov. 5.	Oct. 16.	54
St. Louis de Gonzague, Que., bridge abutments	Oct. 29.	Oct. 16.	48
Toronto, Ont., annual supplies	Oct. 28.	Oct. 9.	46
Toronto, Ont., sewers	Oct. 28.	Oct. 16.	48
Winnipeg, Man., transformers	Nov. 3.	Oct. 16.	50

BRIDGES, ROADS AND STREETS

Abbotsford, B.C.—The Abbotsford and District Good Roads Association unanimously approved of a resolution to hard-surface the Yale Rd. from New Westminster to Chilliwack.

Ancaster, Ont.—Tenders will be received by W. A. McLean, Deputy Minister of Provincial Highways, Parliament Buildings, Toronto, until 12 o'clock noon on Wednesday, November 5th, 1919, for the clearing, grubbing, earthwork, rockwork, construction of concrete structures and delivering crushed stone on the provincial highway in the vicinity of Ancaster. Plans and specifications may be seen on and after Monday, October 27th, at the office of the Resident Engineer, Paris, Ont.; at the office of the City Engineer, Hamilton, Ont., and at the office of W. A. McLean.

Banff, Alta.—A rate of 52½ cents per hour for ten-hour day has been set by the local authorities in an endeavor to obtain sufficient labor to complete construction of the government road at Temple Siding, between Lake Louise and Banff.

Bridgeburg, Ont.—The Joint International Committee are planning renewal of efforts to have a peace memorial bridge erected. Should this bridge not be constructed, it is expected that an additional commercial bridge will be erected either here or at Fort Erie.

Campbellford, Ont.—Work on the road from Campbellford to Meyersburg, which is a part of the Northumberland county provincial road system, is expected to begin early next spring.

Carsland, Alta.—The provincial Public Works Department will start work at once on the construction of a steel bridge across the Bow River at Carsland, 40 miles e. of Calgary. Estimated cost, $80,000. Hon. A. J. McLean, Minister.

Chatham, Ont.—City council will issue debentures for $75,000, providing for construction of permanent roads throughout the city.

Cloverdale, B.C.—Applications have been received by the Surrey council for improvements on the following roads: Sunnyside, Davis, Newton and White Rock. It is not likely that any new work will be undertaken before next spring.

Goderich, Ont.—Town council contemplates widening South St. on the east side, from Britannia Rd. and Blake St. L. L. Knox, town clerk.

Granby, Que.—The Granby township council will complete, next spring, the construction of the remaining 4 miles of gravelling on the road from Adamsville to Granby township line.

Halifax, N.S.—City engineer is preparing estimates of cost of construction of concrete sidewalks for w.s. of Robie St., from St. Alban to Almon St.; e.s. of Henry St., Coburg Rd. to Morris; and n.s. of Quinpool Rd., from Harvard to Oxford St. F. W. W. Doane, city engineer.

Hastings, Ont.—The Department of Highways has authorized the construction of a first-class metal road from Havelock to Trent River, a distance of between two and three miles. It will be constructed of trap-rock from the Ontario Rock Co.'s quarry at Preneveau, Ont.

London, Ont.—City council intends to construct a cement walk on South McKenzie Ave., from Ridout to a point opposite Marley Place. City clerk, S. Baker.

London, Ont.—Committee has recommended that an estimate of cost of new bridge over the Thames river at Ridout St. be prepared by the city engineer's department. In the meantime, repairs will be made to the old bridge. Estimated cost of repairs, $1,500. H. A. Brazier, city engineer.

London, Ont.—Ratepayers of the eastern district are requesting council to proceed with repairs of pavement on East Dundas St., from McCormick's factory to the city limits.

Montreal, Que.—It is reported that the provincial government intends, next year, to issue debentures providing $10,000,000 for construction of five new provincial improved highways as follows: Montreal—Laurentian Rd., 140 miles; Longueuil—Levis, 180 miles; Levis—Rimouski, 185 miles; Montreal—Sherbrooke, 100 miles; Ste. Thérèse—Hull, 125 miles.

North Vancouver, B.C.—The Good Roads League of British Columbia, at its third annual convention, held here recently, passed a resolution to ask the provincial government to carry out extensive road-building and road improvements. Mayor R. H. Gale, of Vancouver, is president of the league.

Ottawa, Ont.—By-law has been passed ratifying the agreement between the city of Ottawa and the county of Carleton for the taking over of toll roads within the radius of 12 miles from the city.

Ottawa, Ont.—Parts of the Richmond road, extending from Ball's corners to Richmond and from Dwyer Hill to the town line between Goulburn and Beckwith, will be declared a county highway by the passing of the necessary by-law.

Ottawa, Ont.—The new Chaudiere bridge has now been completed with the exception of the roadway. It is expected that the structure will be opened for traffic about December 1st, 1919.

Perth, Ont.—The provincial Highway Department has approved of the construction of a road from Perth to Renfrew, via Lanark and Calabogie.

Peterborough, Ont.—Council has closed Bethune St., between Brock and Murray St., while the C.P.R. is constructing a new bridge over the creek on the Lakefield division.

Portage la Prairie, Man.—Council is considering estimates from the engineer, providing for construction of road

to Delta. Built-up grade, without gravelling, cost, $5,500; with gravelling, $25,000 to $30,000.

Quebec, Que.—City council has adopted report of the civic finance committee recommending expenditure of $50,000 for pavements.

Regina, Sask.—Commissioner Thornton will proceed to improve the boulevard along the centre of Victoria Ave., east of Broad St. The boulevard will be filled, graded and seeded. Alderman Burton.

Rockwood, Man.—Tenders will be received by V. W. McFarlane, secretary-treasurer, until noon on Friday, October 24th, 1919, for the gravelling of approximately 37 miles of road. Plans may be secured from A. McGillivray, Highway Commissioner, Winnipeg, or from D. W. Mawhinney, Municipal Engineer, Stonewall, Man.

Sherbrooke, Que.—Two surveys have been completed for location of the new provincial highway between Beauce and Sherbrooke. One route runs from Beauce Jct. via Thetford, Black Lake and Weedon to Sherbrooke, while the other route runs from Beauceville via St. Evariste to Sherbrooke. Hon. J. A. Tessier, minister of roads has inspected both locations and will soon make definite decision.

St. Thomas, Ont.—The provincial highway, from London to Windsor, will follow the southerly route through St. Thomas, according to Hon. F. G. Macdiarmid, Minister of Public Works and Highways.

Toronto, Ont.—Tenders will be received until noon, October 28th, by the board of control for construction of the following works: Asphalt Pavements—Bristol Ave., from Geary Ave. to 1,000 ft. w.; Herman Ave., from Ritchie Ave. to w. end; Hiawatha Rd., from Applegrove Ave. to Gerrard St.; Sackville St., from Winchester St., to n. end (except intersection of Amelia St.). Granite Block Pavement—Eastern Ave., from St. Lawrence St. to Broadview Ave. (except 227 ft. across Don bridge, railway tracks and sidings). Concrete Curbing—Bristol Ave., e.s., from 150 ft. 6 in. n. of Geary Ave. to 181 ft. farther north. T. L. Church, chairman.

Whitby, Ont—Under the direction of the County Road Superintendent, the county will spend over $3,000 on the Brock St. section of the road. A short cement bridge will be erected.

Windsor, Ont.—City council is considering a proposal to widen London St., between Ouellette and Bruce Ave.; also to pave London St., from Ouellette Ave. westerly.

Winnipeg, Man.—The Good Roads Board authorized construction of 277 miles additional market roads throughout the province. Estimated cost, $678,000.

Yarmouth Tp., Ont.—A petition was presented to the township council, asking that a 4-ft. granolithic walk be constructed on the west side of Park Ave., from Mary St. to Wellington St. Council will obtain a report. Clerk, W. C. Caughell, St. Thomas, Ont.

York Tp., Ont.—A deputation from the Davies estate, Todmorden, requested the township council to lay water mains on the property. Frank Barber, township engineer, will report.

York Township, Ont.—Contracts have been awarded by township council for construction of sidewalks as follows: Barr Ave., to Angotti and Smythe, $1,175. Rejected tender, Sheridan, $1,757; Brownhill Ave. to Sheridan, $2,924. Rejected tenders from Angotti and Smythe, $4,350; A. Johnson, $4,140. Eversfield Ave. to Grant, $3,950. Rejected tenders, A. Johnson, $5,125; National, $4,988; Sheridan, $7,074.50. Glenholme Ave., s. of Medway Ave., to Township Engineer, $958. Rejected tenders from A. Johnson, $1,800; National, $1,508; Sheridan, $1,453.80. Keene St., to A. Johnson, $1,350. Rejected tenders from National, $1,580; Sheridan, $1,768. Lauder Ave., to Township Engineer, $750.75. Rejected tenders from A. Johnson, $950; National, $888; Sheridan, $1,256.70. Pape Ave., to J. E. Clarke, $4,500. Rejected tenders from Grant, $4,775; A. Johnson, $6,000; National, $6,788; Sheridan, $7,316; Walton and Rowell, $6,300. Weston Rd., to National, $3,988. Rejected tender from Angotti and Smythe, $4,232; A. Johnson, $4,300; Sheridan, $6,233. Frank Barber, engineer.

WATER, SEWAGE AND REFUSE

Amherstburg, Ont.—Tenders will be received until Octoger 25th by Anderdon township council for cleaning out and enlarging the Sinasac drain. A. C. Mailloux, clerk, Amherstburg.

Brantford, Ont.—Lee and Lee have presented to the Water Commission an estimate of the cost of constructing a filtration system here, estimated cost being from $500,000 to $600,000.

Calgary, Alta.—The Utilities Commission Board has approved plans for a new sewage disposal plant for the city of Calgary. By-laws will probably be submitted to the ratepayers at an early date.

Edmonton, Alta.—The provincial Public Utilities Commission have granted permission for towns to issue debentures as follows: Grande Prairie, town hall and waterworks extension, $10,500; Drumheller, waterworks extension, $21,000.

Fort Erie, Ont.—The village council has let the contract for the new suction wheel to be sunk at the waterworks pump-house to Bradley Wheeler at a price of $1,900.

Halifax, N.S.—City council will call for tenders for construction of sewer on Carteret St. F. W. W. Doane, city engineer.

Halifax, N.S.—The following contracts will soon be awarded by the city council: 6-in. water main on Barrington St., from Hurd St., s. 300 ft.; water main in lane from the Infectious Hospital to Robie St.; water main on Connolly St., from Chebucto Rd., n. 300 ft.; water main on MacDonald and Patricia Sts., from Flynn St. to Chebucto Rd.; sewer and water mains on Russell St., from Robie St., e. 400 ft.; sewer on North Park St., from Cogswell St. to Cornwallis St.; sewer on Kline St., from Quinpool to Oak St.

Hamilton, Ont.—Council contemplates construction of a sewer extension along Burlington St. to the new site of the Firestone Tire and Rubber Co. Estimated cost, $34,000. E. R. Gray, city engineer.

Hamilton, Ont.—Contracts will soon be awarded by Board of Control, City Hall, Hamilton, for the construction of the following pipe sewers: Cannon St., from Gage Ave. to Balsam Ave.; Paradise Rd., from Dundas St. to a point 250 ft. south of Adelaide St.; Aberdeen Ave., from a point 120 ft. west of Chedoke Ave. to a point 210 ft. westerly; Macnab St., from Hunter St. to a point 190 ft. northerly; Ottawa St., from Main St. to Maple Ave. E. R. Gray, city engineer.

Hawkesbury, Ont.—F. A. Dallyn, provincial sanitary inspector, has inspected and approved the filtration plant recently completed for the town of Hawkesbury. Contractors, Archambault and Leclair, Montreal. Engineers, Jas. O. Meadows, Montreal.

Kingston, Ont.—Board of Health recommends to council construction of sanitary sewers on Macdonnell St. and on Lansdowne St. westerly to west limit of lot No. 1.

Kingston, Ont.—City council has granted the application of the Civic Utilities Commission for construction of the following works: Water main on Ellerbeck St., between Union and King St.; water main on Concession St., between Victoria and Princess St.; gas main on Brock St., between Nelson and Victoria Sts.

Kirkfield Park, Man.—Tenders will be received until 4 p.m., November 4th, for construction of a sewer, laying of water mains, valves, hydrants, etc., on Queen St., St. James, from Portage Ave. to Silver Ave. Frank Ness, secretary-treasurer.

Kirkfield Park, Man.—The council of the rural municipality of Assiniboia contemplate construction of a 5-in. well

Brant Road, Galt, Ont. Tarvia modified modern pavement built in 1911. Treated with "Tarvia-B" in 1916.

A view of St. Andrews Street, Galt, Ont. Surface-treated with "Tarvia B" in 1916 and 1918.

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The small photograph in the oval shows St. Andrew's Street, built originally as a water-bound macadam street and treated with "Tarvia-B" in 1916 and again in 1918.

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and equipping same with pump and platform. F. Ness, secretary-treasurer.

Lindsay, Ont.—Town council is considering the construction of a relief storm sewer from Kent St. to Peel St. as part of a comprehensive storm sewer from the head of Sussex St. Estimated cost, $1,500. Town engineer, O. Smith.

London, Ont.—City council intends to construct a 10-inch sewer on both sides of Sackville St., from Hamilton Rd. to Grafton St., at an estimated cost of $5,889.15. City clerk, S. Baker.

London, Ont.—City council contemplates a policy of concrete bridge construction to replace the existing steel structures, which are rapidly wearing out. Estimated cost of concrete bridge over Thames River at Ridout St., if authorized, would cost approximately, $50,000.

Midland, Ont.—Council has passed by-law providing for extension of the waterworks and lighting systems, construction of which is partly completed. Estimated cost, $30,000.

Moncton, N.B.—Contract has been awarded by city council to Lewis Stevens for construction of sewer on North St. Estimated cost, $5,065. J. Edington, city engineer.

Port Hope, Ont.—Contract has been awarded by town council for construction of sewer on Princess St. to A. A. Outram. Contract price, $800.

Saskatoon, Sask.—Application will be made by the city to the Local Government Board for permission to extend sewers and water mains to the property recently acquired by the North Star Oil and Refinery Co. on Avenue P. Estimated cost, $3,500.

St. John, N.B.—Armstrong and Bruce have requested the city council to extend water and sewage mains into the Mt. Pleasant Court subdivision. Estimated cost, $2,000.

Vancouver, B.C.—The report of the Vancouver and Districts Sewerage and Drainage Board shows that the total cost of constructing the extension of the Bridge St. drainage system was $20,000 less than the lowest tender submitted for this work.

York Township, Ont.—The following contracts have recently been awarded by the council for construction of water mains: Murphy, Belvidere, 6 in., $874; Bathurst St., 12 in., $3,776.20; Corbett St., 6 in., $1,456.92; Sunnybrae, 6 in., $1,066.30; Forest Hill, 6 in., $5,513.78. Rejected tenders, McAuslan and Anderson, Belvidere, $1,081; Bathurst, $6,277; Corbett, $2,882.05; Sunnybrae, $2,122.75; Forest Hill, $8,356.30. From Cavotti, Belvidere, $904; Bathurst, $4,781.50; Corbett, $1,516.30; Sunnybrae, $1,139.45; Forest Hill, $7,160.95. From Grant, Corbett, $2,051.19; Forest Hill, $6,749.66. Frank Barber, engineer.

LIGHT, HEAT AND POWER

Glace Bay, N.S.—The Dominion Coal Co. plans installation of steam turbines to utilize all waste and exhaust steam in developing additional electrical energy. This power would be used for the entire electrification of all new and proposed mines under control of the company.

Glencoe, Ont.—Ratepayers passed a Hydro enabling by-law.

Nanton, Alta.—The provincial Public Utilities Commission have granted permission for issue of debentures for construction of improvements to the electric light plant.

Rivers, Man.—Debentures will be issued by the town of Rivers, providing for installation of electric lighting system and equipment. Debenture issue, $9,000. E. J. Forman, secretary-treasurer.

Toronto, Ont.—The Toronto Hydro-electric will shortly apply to council for $700,000 new capital to provide for large extensions to the system. T. Church, mayor.

Wingham, Ont.—By-laws have been passed by the ratepayers, enabling and authorizing the Hydro-Electric Power Commission to construct a distributing plant, $40,000. Power will be obtained from Eugenia Falls, Ont.

RAILWAYS

Edmonton, Alta.—It is proposed to extend the street railway system down Brandon Ave. in West Edmonton.

Edmonton, Alta.—The city council has granted permission to the C.N. Ry. to construct spur track extensions in the city, between 107th and 108th Sts. to Athabasca Ave.

Elmira, Ont.—The Ontario Hydro-Electric Commission has prepared estimates of the cost of an electric railway, from Elmira to Kitchener, Galt and Dundas connecting with the contemplated lines from Toronto and London and to Niagara Falls as well as from Guelph to Preston and Galt. This information is contained in a letter received by the city council from Sir Adam Beck.

Galt, Ont.—The engineers of the Hydro-Electric Power Commission have prepared a report on the proposed Hamilton-Elmira radial. By-laws will probably be submitted, on or before January 1st, 1920, to the ratepayers of Hamilton, Galt, Preston, Hespeler, Guelph, Kitchener, Waterloo and Elmira. Sir Adam Beck, chairman.

Montreal, Que.—Ratepayers of the Park Ave. extension district will request extension of car lines through Beaumont, Bremner and Ball Sts.

Saskatoon, Sask.—Council has decided to extend the street railway system along Twentieth St. to the n. side of Avenue H. Estimated cost, $1,818. The intersection of this street will have a bitulithic pavement. Estimated cost, $3,573. Commissioner Yorath.

Sydney, N.S.—Board of works has recommended to council to grant permission for the installation of a new siding, 320 ft. in length, on Victoria Rd., near the fire station.

Toronto, Ont.—The Ontario Railway Board has approved plans for construction of Bloor St. civic car line extension.

Toronto, Ont.—The Toronto and Eastern radial by-law will be voted on by West Whitby, Whitby town and Bowmanville on November 17th, and Scarboro' township and Oshawa on November 22nd.

Toronto, Ont.—The Ontario Railway Board has approved the plans of the civic car line on West Bloor St., from Quebec Ave. to Runnymede Rd., and the Board of Control has decided to recommend that the necessary $160,000 for the double-tracking be financed without seeking the approval of the ratepayers.

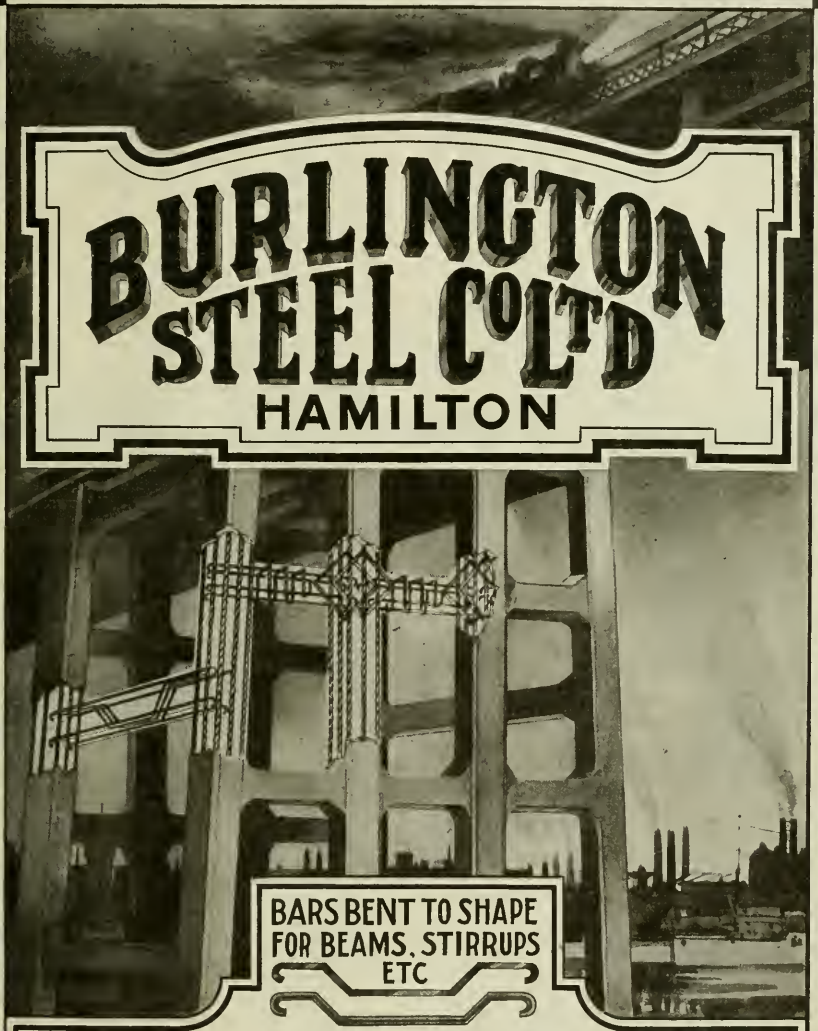
Toronto, Ont.—Application has been made by the Hydro-Electric Power Commission of Ontario to the Ontario government for two orders-in-council, one of which is to permit the Commission to enter into negotiations with the Detroit United Railway for the acquiring of the properties of the Sandwich Windsor and Amherstburg Railway Co. and the Windsor-Tecumseh Co., which also include the electric distribution systems in the municipalities of Windsor and Sandwich. The amount involved is over $2,000,000. The second order-in-council is to enable the Commission to have by-laws submitted to the electors of the several municipalities on the line of the proposed railway from Hamilton to Elmira via Galt, covering the estimates and agreements for the construction and operation of the line.

Windsor, Ont.—The Hydro-Electric Power Commission has applied for an order-in-council for permission to submit a by-law to the ratepayers of the border municipalities authorizing purchase of the Sandwich, Windsor and Amherstburg street railway. Estimated purchase price, $2,000,000. Sir Adam Beck, chairman.

FACTORIES AND LARGE BUILDINGS

Bienfait, Sask.—It is rumored that the Dominion government will establish the new lignite briquetting plant at Bienfait, and that construction will commence in April, 1920.

Belleville, Ont.—The Ontario Oakoal Co. will erect a plant for manufacture of Oakoal. The city garbage disposal question will be solved by delivery to the new company.



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Campbellford, Ont.—The town council carried a motion at a recent meeting authorizing the town solicitor to prepare a by-law to raise by debentures $69,000 for the purpose of building a new high school.

Chatham, Ont.—Engineers who have charge of the solution of Chatham's water problem have made a preliminary report of the cost of alternative schemes for the future source of supply. It is estimated that to bring water from the Snve Carte will cost $720,000, from Lake Erie $600,000, and from the River Thames $300,000. Tests show that the lake water is the most satisfactory.

Dartmouth, N.S.—By-laws have been passed which will bring the town under the provisions of the Nova Scotia Housing Act. The following commissioners have been appointed; W. H. Covert, G. Mitchell, R. Elliott for a term of three years each, Capt. Livingston and J. J. O'Toole, one year each.

Didsbury, Alta.—The contract for the new high school has been awarded to Emerson Morrison, of Didsbury. Architect, Charles Hay, Calgary.

Edmonton, Alta.—City council will construct a rest and check room at the East End park. Estimated cost, $4,000.

Edmonton, Alta.—Permission has been granted by the provincial public utilities commission for issue of debentures as follows; Fort Saskatchewan, school, $11,000; Vegreville, school, $10,000.

Fort William, Ont.—The city council has authorized the mayor and clerk to sign agreement turning over the site for the new skating rink to the Fort William Arena Rink Co.

Glace Bay, N.S.—The town council has been authorized to borrow $20,000 for construction of a new school to relieve congestion at the Central school on Park St.

Glencoe, Ont.—The I.O.D.E. are raising funds for construction of a proposed memorial hall.

Halifax, N.S.—Plans are being formed for construction of a new synagogue. Estimated cost, $30,000.

Halifax, N.S.—Plans are being prepared for construction of a new Baptist temple on the corner of North and Brunswick St., and a new parsonage across the road. Estimated cost, $75,000. Rev. H. R. Boyer, pastor.

Hamilton, Ont.—The Norton Co. of Canada, Ltd., will construct factories on Lottridge St. immediately.

Hamilton, Ont.—Contract has been awarded to J. B. Nicholson, Ltd., of this city, for the erection of a $50,000 reinforced concrete elevator for the Yates-Lehigh Coal Co., Buffalo, N.Y.

Hamilton, Ont.—By-law will be submitted to the ratepayers on January 1st, providing for construction of fences, grounds, bleachers and stands for the proposed athletic field at Scott Park.

Hanover, Ont.—A movement is on foot to collect $40,000 for the erection of a Y.M.C.A. building.

Ingersoll, Ont.—By-law has been passed by the ratepayers providing for construction of a new sixteen-room school. Estimated cost, $120,000.

Kingston, Ont.—The urgent need for a new school was brought to the attention of the members of the Board of Education in a report submitted by Inspector J. Russell Stuart.

Lethbridge, Alta.—Contract for alterations to the general offices in the local C.P.R. depot has been awarded to Smith Bros. and Wilson, for the general work. The electric fixtures will be installed by the Roy Electric Co., and the heating by the Hick-Sehl Hardware Co. Work is now going on. Total estimated cost of alteration, $7,000.

London, Ont.—A High and Public School extension programme, to be carried out next summer, which will entail an expenditure of half a million dollars, is projected by the Board of Education. Chief inspector, C. B. Edwards.

London, Ont.—An announcement has been made that the Arts Faculty of the Ursuline Academy of Chatham and L'Assomption College, Sandwich, which were recently affiliated with the Western University here, have purchased 40 acres of land adjoining the new site for the university. Both the college and academy will proceed without delay with the erection of buildings to cost between $100,000 and $150,000 each.

London, Ont.—Contract has been let to John Putherbough, of London, for the erection of a new medical college building. Approximate cost, $305,000. The work will be undertaken at once.

Moncton, N.B.—Project is under way for construction of a large skating rink building.

Montreal, Que.—W. A. Humphrey has commenced construction of a two-story garage, size, 50 by 100 ft., on the site of the old curling rink on Mechanic St.

Montreal, Que.—The Canadian Steel Tire and Wheel Co. is constructing a large plant at Montreal for manufacturing steel tires for railway equipment.

Montreal, Que.—Work has been started on the foundations for a new reinforced concrete building on Phillips Square. The work is being done by the Foundation Co., Ltd., Montreal. Ernest Cormier, New Birks Bldg., is the architect. The building will have 175 ft. frontage on Phillips Place with a depth of 134 ft., and will be eight stories high.

Montreal, Que.—The Canadian Vickers Co. have announced their intention of forming an amateur athletic body amongst the employees of the shipbuilding concern, and plans are already under way for the construction of a large clubhouse. A site is now being sought in Maisonneuve.

Nelson, B.C.—At a recent meeting of the Board of Trade a resolution was unanimously adopted, calling for the Dominion government to provide an ore-testing plant to the interior. F. A. Starkel, E. W. Widdowson and R. W. Hinton were appointed a committee to draft a telegram on the subject, to be dispatched to the federal Minister of Mines.

New Westminster, B.C.—The Housing Committee will shortly call for tenders for the erection of houses.

Northern Ontario.—The Associated Goldfields Mining Co., Ltd., which possesses large areas at Larder Lake, in Northern Ontario, proposes to erect a large mill. General superintendent and manager, C. G. Daimpre.

Oak Bay, B.C.—Ratepayers passed a by-law authorizing the erection of a new school building.

Oshawa, Ont.—J. F. Burke is making extensive alterations to the Central Hotel. Estimated cost, $8,000.

Ottawa, Ont.—The Carnegie Public Library Board has awarded contract for changes in the main hall to Taylor and Lasky. Board also contemplates construction of branch libraries in Ottawa South, estimated cost $25,000, and on King Edward Ave., estimated cost $35,000. W. G. Black, chairman.

Peterborough, Ont.—The McDonald Lumber Co. will erect a new box factory immediately, and other extensions in the near future. The site of the new addition is a section of Crescent St., between Rink and Perry St. and has been purchased from the city council for $25. C. McDonald, Peterborough.

Peterborough, Ont.—The Nashua Gummed and Coated Paper Co. will remodel and equip the old cordage works. Construction will soon commence.

Point Grey, B.C.—Seventeen additional new homes will be constructed by the housing commission.

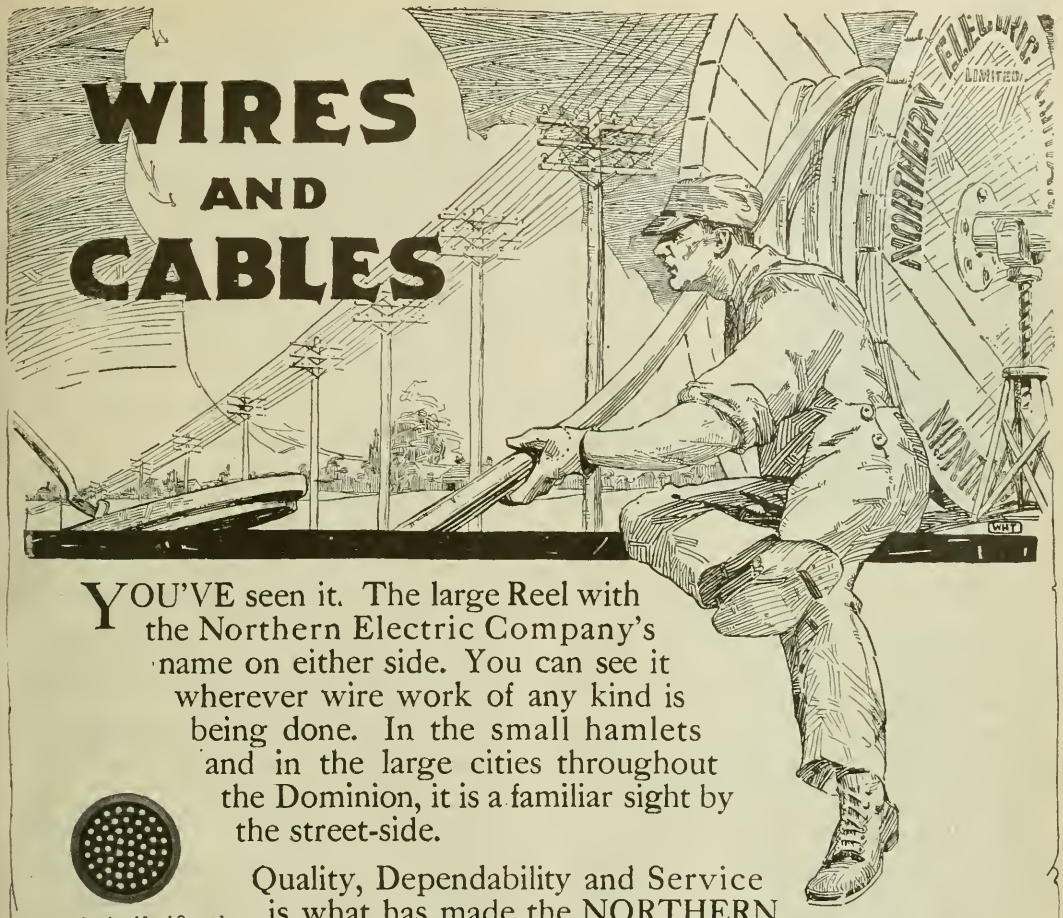
Quebec, Que.—Contract has been awarded to J. Gosselin for construction of the new chapel to be built in St. Lawrence Ward, Levis. Contract price, $7,000.

Regina, Sask.—The Ford Motor Car Co. of Canada, Ltd., contemplates construction of a factory. Estimated cost, $100,000.

Regina, Sask.—Contract has been awarded by the S.O.E. for construction of an addition to hall to F. Chestnut. Contract price, $2,200.

Renfrew, Ont.—The Carnegie Corporation of New York have granted funds for construction of a public library building. Amount available, $16,000.

WIRES AND CABLES



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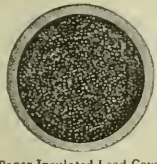

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Renfrew, Ont.—Ratepayers have passed by-law providing for construction of a new fire hall, which will also contain a central heating plant. Estimated cost, $25,000.

Rockyford, Alta.—Tenders will be received until noon, October 31st, by the board of trustees, Jarvis School district No. 3827, for erection of a frame school building. F. G. B. Swigart, secretary-treasurer, Rockyford, Alta.

Sandwich East, Ont.—The General Motors Corporation have purchased land on Walker Rd. as a site for their model townsite. Estimated cost of buildings, $1,000,000.

Saskatoon, Sask.—City commissioners will request loan of $200,000 from the government for construction of dwellings.

St. Hippolyte, Que.—Tenders will be received until November 8th, by the Protestant school commission, for construction of the Protestant School of Saint Hippolyte. Joseph Gohier, secretary-treasurer.

Stratford, Ont.—By-law will be submitted to the ratepayers on January 1st, 1920, providing for completion of improvements and construction of buildings at Queen's Park. Estimated cost, $25,000. R. T. Orr, chairman, parks board.

Thornbury, Ont.—The Thornbury grist mill, which was owned by that town, and operated by W. Moore and Sons, of Meaford, Ont., was completely destroyed by fire recently. Estimated loss, $20,000. The Thornbury electric lighting plant, which was located in the same building, was also destroyed.

Toronto, Ont.—Members of St. Patrick's parish will erect a parish hall.

Toronto, Ont.—The Downes Dunlop Co. will construct a three-story brick store and apartment at the corner of Danforth and Pape Ave. Estimated cost, $50,000.

Toronto, Ont.—Plans have been prepared for construction of a new reception hospital for incipient cases of insanity. Plans provide for a main building with four angle wings, main building to be two-story and basement. Commissioner Chisholm, property department.

Toronto, Ont.—The Board of Education will call for tenders for the erection of a caretaker's house on the Norway School grounds, the building to be constructed from the material of the house now being torn down to make way for the addition to the school. The price limit fixed is $3,500.

Toronto, Ont.—A building permit has been issued by the city architect's office for the erection of the Northern Aluminum Co's new warehouse and factory on Sterling Rd., which is to cost $358,000.

Toronto, Ont.—According to a statement made recently by Rabbi Jacobs, of Bond St. Synagogue, it is intended in the near future to build a new synagogue in the north-west section of the city which will be the largest of its kind in Canada.

Toronto, Ont.—Geo. W. Gouinlock, architect, submitted plans to the Board of Education for the proposed addition to Parkdale Collegiate Institute. Accordingly, the architects were instructed to submit estimates so that tenders could be asked for.

Trenton, Ont.—The Chemical Products of Canada, Ltd., proposes to erect a plant here.

Vancouver, B.C.—Plans are being prepared for construction of a large modern auditorium theatre to have a seating capacity of 2,200. H. J. Porter, secretary-treasurer.

Vancouver, B.C.—The Sumner Metal Works, of Everett, Wash., has decided to establish a Canadian factory. The plant of Allan & McKelvie has been secured and will be enlarged to the required capacity. A. McKelvie, secretary-treasurer.

Waterloo, Ont.—Excavation has commenced on foundations for construction of a two-story addition to the Mutual Life Assurance Co. building. Architect, H. Horner, Toronto.

Winnipeg, Man.—The Winnipeg housing commission will construct 200 houses next spring.

Winnipeg, Man.—Carter, Halls and Aldinger have commenced construction of new plant in St. Boniface for the Western Wheel and Foundries Co. Estimated annual capacity of plant, 100,000 car wheels.

Winnipeg, Man.—Construction has commenced on the first temporary building, which will contain 25,000 sq. ft. of lecture space, and will accommodate 900 students for lectures and laboratory work. Estimated cost, $85,000.

Winnipeg, Man.—The Winnipeg Housing Commission will construct three houses on Hart St., Elmwood. The houses will be constructed in red brick, and will be of four, five and six rooms. H. C. Thompson, chairman.

Winnipeg, Man.—Archbishop Matheson, of the Anglican church, is planning erection, next year, of a memorial cathedral, to be constructed on the banks of the Red River in commemoration of the centenary of the establishment of the church.

Yarmouth Tp., Ont.—Township council passed a by-law to provide for the erection of two schools. Clerk, W. C. Caughell, St. Thomas, Ont.

Zurich, Ont.—H. Gundel, of London, will establish a glove factory here.

MISCELLANEOUS

Amherstburg, Ont.—The Detroit and Windsor Ferry Co. will soon complete construction of the new concrete docks. The floors in the waiting-room and shelter will be finished in concrete and tile.

Collingwood, Ont.—Tenders addressed to R. C. Desrochers, secretary, Department of Public Works, Ottawa, will be received until 12 o'clock noon, Thursday, November 6th, 1919, for the breakwater reconstruction, being the renewal of the superstructure of part of the eastern breakwater at Collingwood. Plans may be seen and specification obtained at the Department of Public Works, Ottawa; at the office of the District Engineer, Equity Building, Toronto, Ont., and at the post-office, Collingwood, Ont.

Edmonton, Alta.—Permission has been granted by the provincial public utilities commission for issue of debentures as follows: Mundare, fire protection, $8,000; Vermilion, fire hall and fire protection service, $20,000.

Esquimalt, B.C.—Skinners Cove, Esquimalt, has been selected as the site of the drydock to be built by the federal government.

London, Ont.—City council contemplates purchase of three vacuum sweepers for street cleaning. Contract for flusher recently called by tender will not be awarded until the vacuum sweepers have been tried experimentally. H. A. Brazier, city engineer.

New Westminster, B.C. — City council contemplates dredging the Fraser river at Peplar Island shipyard.

Niagara, Ont.—The lake level committee of the Sanitary District board, Chicago, has recommended the immediate construction of a system of gates in the Niagara and St. Lawrence rivers, at the expense of the Sanitary district. The gates are proposed to assure surface elevations of Lakes Michigan, Huron and Erie, and the lower St. Lawrence River, which will all remain at the present levels in spite of the proposed diversion of 10,000 c.f.s. from Lake Michigan at Chicago.

Ottawa, Ont.—Tenders will be received until noon, November 8th, for manufacture, supply, delivery and erection of kitchen equipment for the new parliament buildings, Ottawa. J. A. Pearson, architect.

Outremont, Que.—Council contemplates construction of an incineration plant which will burn garbage as fuel for raising of steam to operate sewer pumps. Estimated cost of building and plant, $15,000.

Quebec, Que.—It is the intention of the Harbor Board to rush to completion the work that has already been started on the waterfront and to make the improvements that have been decided upon, including the construction of concrete and brick sidewalks to replace the present wooden ones.

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C.E.—23-10-19

Quebec, Que.—The Three Rivers shipyards have started work on a new 6,500-ton vessel that will be the largest ever built of steel in a Canadian shipyard. Another steel ship of 5,500 tons will shortly be put on the ways. Both are being built for a French navigation company.

St. John, N.B.—Council has authorized purchase of the following: Material from T. McAvity and Sons, Ltd., main stop cock vault covers, $20 each; sewer manhole covers, $14 each; from Union Foundry and Machine Works, Ltd., catch basin taps for tide inlets, $9 each; catch basin frames, $6 each; catch basin gratings, $4 each; service stop cock boxes, $4 each. G. N. Hatfield, city engineer.

Vancouver, B.C.—C. C. Ballantyne, minister of marine and fisheries, Ottawa, has announced that plans will soon be prepared, and construction commenced on the development of Vancouver harbor. H. H. Stevens.

Vancouver, B.C.—The Dominion government dock at Burrard Inlet has been transferred to the C.N. Ry. Plans are being prepared for equipping this dock with heavy lift cranes, derricks, etc. A. E. Warren, general superintendent, western lines.

Verdun, Que.—The city engineer has been authorized by the city council to prepare a report for presentation to the federal government with a view to securing aid in the construction of a dike.

Victoria, B.C.—Tenders will soon be called by the Dominion government for construction of the Esquimalt drydock. Borings are being taken and the plans will soon be completed. Dr. S. F. Tolmie, minister of agriculture.

Wiarton, Ont.—The town council has sold the casket factory to C. Hill. Purchase price, $7,000. New machinery will be installed and many improvements made. J. H. Fielding, town clerk.

Winnipeg, Man.—The Laura Mines, Ltd., a new mining company in northern Manitoba, has been incorporated with a provincial charter and a capital stock of $2,000,000. The mine is situated in the Rice Lake district.

Tenders Called For

NOTICE TO CONTRACTORS

Sealed tenders, marked, "Tender for Ancaster Hill Work," will be received by the undersigned until twelve o'clock noon on Wednesday, November 5th, 1919, for the clearing, grubbing, earthwork rockwork, construction of concrete structures and delivering crushed stone on the Provincial Highway in the vicinity of Ancaster.

Plans, specifications and forms of tender may be seen on and after Monday, October 27th, at the office of the Resident Engineer, Paris, Ontario; at the office of the City Engineer, Hamilton, Ontario, and at the office of the undersigned.

A marked cheque for Five Hundred Dollars, payable to the Minister of Public Works and Highways, Ontario, must accompany each tender.

A Guaranty Company's Bond for ten per cent. of the amount of the tender will be required when contract is signed.

The lowest or any tender not necessarily accepted.

W. A. McLEAN,
Deputy Minister of Highways.

Department of Public Highways,
Toronto, October 15th, 1919. 366

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GOOD OPENING for ambitious young man, graduate in Mechanical Engineering, preferably under thirty years of age. Canada Forge Co., Welland. 362

WANTED.—Experienced Structural Steel Detailers and Checkers. Apply, stating experience and salary required. Manitoba Bridge and Iron Works, Ltd., Winnipeg, Man. 365

WANTED.—Detailers for reinforced concrete and factory buildings. Splendid openings for right men. E. H. Darling, Consulting Engineer, 604 Spectator Building, Hamilton, Ont. 367

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ENGINEER WANTED to take charge of Engineering Department for large pulp and paper company who are making large extension to their development. He must have a good education and years of experience in similar position. He must have good executive ability, experience in making out specifications and contracts and in buying. Salary, $10,000 a year. With applications pleace give information in detail as to education, experience, age, married or single, and copy of references. Address Box 15, *Canadian Engineer*, Toronto.

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Circular, Two-Story, Reinforced Concrete Structure, Approximately 23 ft. Diameter and 20 ft. High, Built Entirely Below Ground Level Excepting Housing for Stairway—Lower Compartment, Containing Pumps, Encircled by Suction Well and Force Main

By CHARLES W. TARR
Deputy Chief Engineer, Morris Knowles, Ltd., Windsor, Ont.

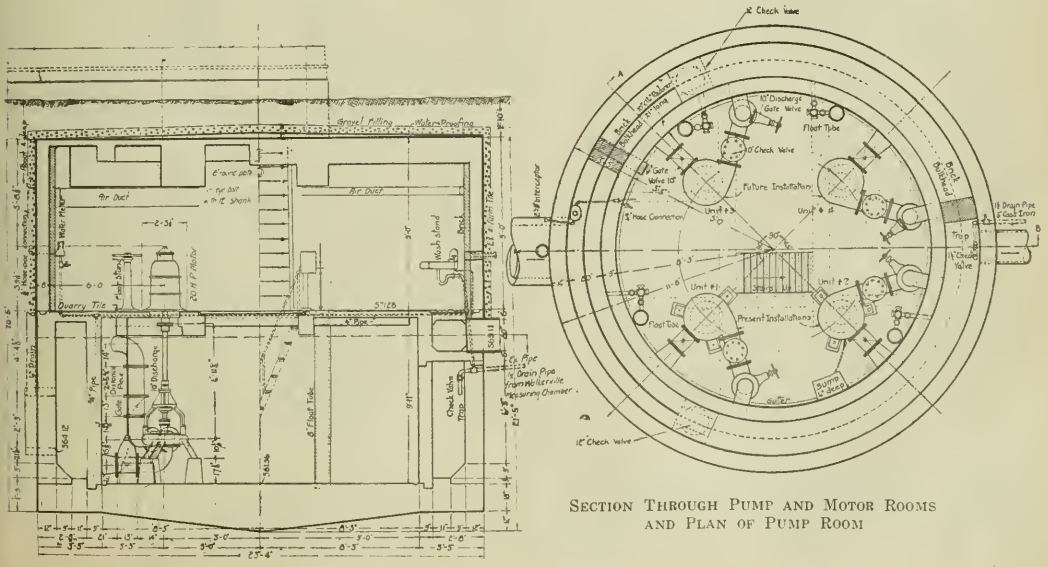
THE sewage pumping station referred to in this article is located in Walkerville, Ont., and is part of a general scheme of the Essex Border Utilities Commission to provide sewerage and sewage disposal for the Essex Border District. This district includes an area about 2 miles wide by 10 miles long, bordering on the Detroit River, and includes Windsor, Walkerville, Ford City, Sandwich, Ojibway and portions of the townships of Sandwich West and Sandwich East.

The commission now has under construction 2½ miles of intercepting sewer to serve the south end of the district, and in June last completed 2½ miles of sewer which will serve the east end, the latter sewer being known as the east interceptor.

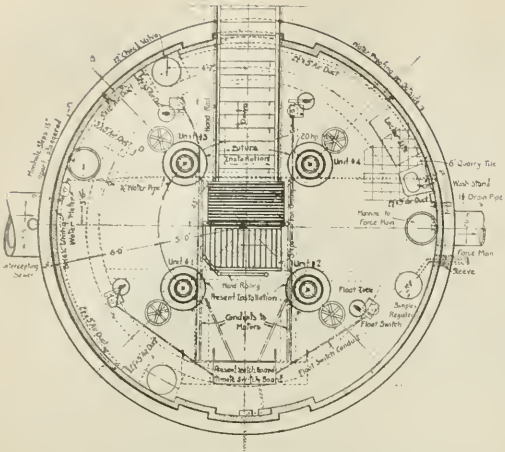
The Walkerville pumping station is necessary to complete and put into operation the east interceptor. Owing to the level topography along the Detroit river, the depth to which it would have been necessary to carry the interceptor to secure a proper gradient, would have been prohibitive, so provision has been made to raise the sewage at an intermediate point, from which it will again flow by gravity to the disposal site. Until such time as the central section of the interceptor is built, the sewage will pass through a temporary outlet into the Detroit river below the water works intakes.

The pumping station is a circular, two-story, reinforced concrete structure, 23 ft. 4 ins. in diameter and 20 ft. 5 ins. high, all built below ground with the exception of the superstructure which houses a stairway leading to the floors below, somewhat on the style of a subway entrance. The upper compartment contains the electric motors, while the lower compartment contains the vertical pumps and is entirely encircled by an annular suction well, above which is the force main. The circular design for the station was chosen, after a careful study of all the factors, because it gave a very efficient and compact arrangement for the pumping units, and allowed a very considerable saving of reinforcing steel and concrete.

The pumping equipment will consist of four units, two of which will be installed at present. The other two will be added when required. Each unit consists of a 20-h.p. vertical motor and a 2,000-gal. vertical centrifugal sewage pump. The units will be automatic in operation, and the motors will



SECTION THROUGH PUMP AND MOTOR ROOMS AND PLAN OF PUMP ROOM



PLAN OF MOTOR ROOM

be started and stopped by a float-operated switch attached to a copper float in an 8-in. wrought-iron float tube, and actuated by the rise and fall of sewage in the suction well. For the present population served by the station, one pump will be sufficient and the other will be used as a spare and later to assist during peak load when additional units are installed. For the ultimate conditions, when the district tributary is more densely populated, four pumps will be required, one of which will be a spare.

The lower compartment, containing the pumps, is encircled by two compartments, from one of which the pumps draw their suction, discharging into the other, which is connected by a force main to the gravity sewer at a higher level.

The upper compartment, or motor room, will eventually contain four vertical motors, four float switches, the switchboard, wash-stand, lockers for supplies, etc., and a venturi meter register. The sewage will be measured by a venturi tube situated in a chamber on the force main about 50 ft. from the pumping station, the pressure pipes being led back to the register in the motor room.

Power

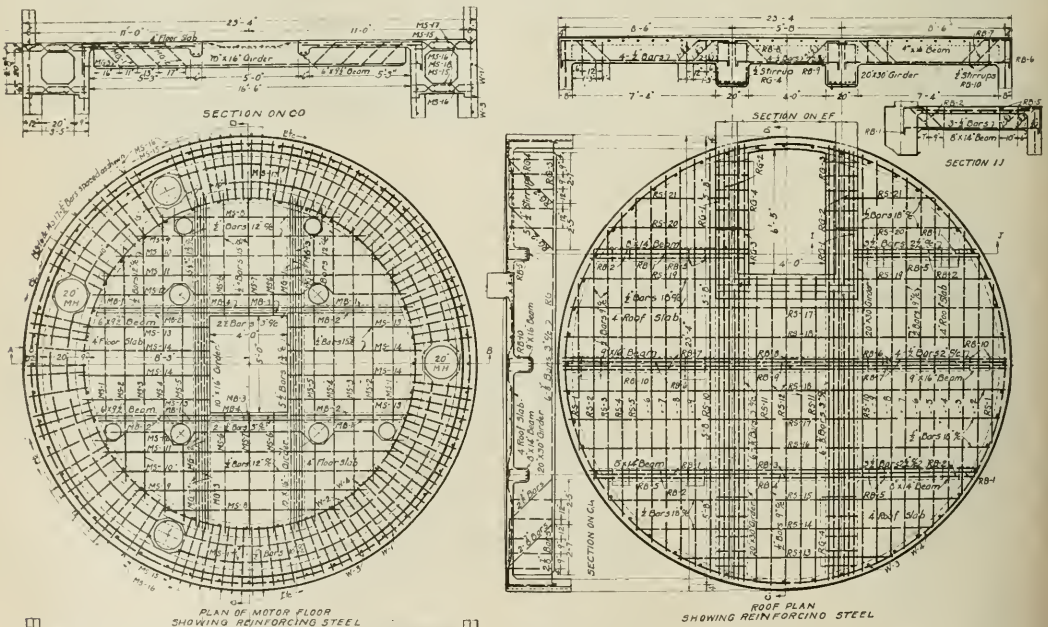
"Hydro" current will be used, and to provide for interruptions in current flow, 12-in. check valves are placed between the suction and discharge chambers, so that should the sewage rise to a sufficient height in the suction well, it would flow through the check valves and on into the force main with the minimum damage, if any, by flooding the interceptor and overflowing into the river.

Interior Finish

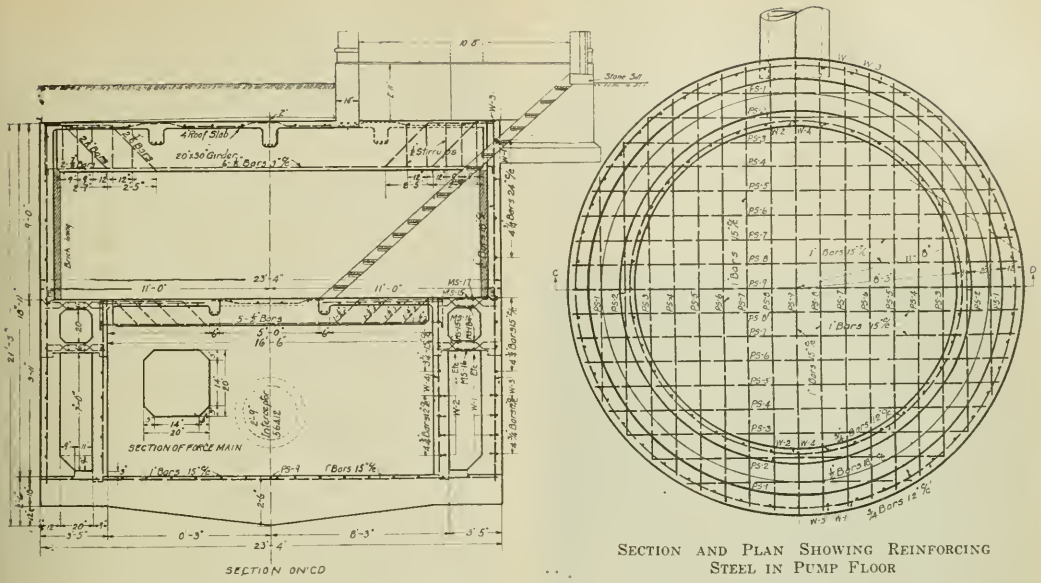
The motor room will be lined with a light-colored brick and will have a red quarry-tile floor. The ceiling and girders will be painted with a cream color cement paint. The pump-room will be painted a similar color, but will be a light stone color from the floor to a height of 3 ft. 6 ins.

Ventilation

A system of ventilation will be installed, capable of supplying 500 cu. ft. of air per minute, or a complete change of air in ten minutes. The fan with motor is placed near the roof, from which air ducts are carried to the floor of the motor and pump rooms. The air exhausted by the fan will be expelled through a flue and opening in the side of the superstructure, and fresh air will enter through the stairway



REINFORCING STEEL IN MOTOR FLOOR AND ROOF



SECTION AND PLAN SHOWING REINFORCING STEEL IN PUMP FLOOR

to take its place. This principle of ventilation, by exhausting the air from near the floor, was decided upon because gasoline vapors and other heavier-than-air gases, if encountered, would settle to the floor and require removal.

Waterproofing

The exterior of the pumping station, down to the level of the motor room floor, will be waterproofed with alternate layers of wool felt and coal tar applied hot. Over this, a 6-in. layer of gravel will be placed to drain the ground water from the top and the upper side walls of the station.

Superstructure

As the pumping station is located in a small park containing a bathing beach which is very popular in the summer time, it was deemed desirable to have the superstructure present a pleasing appearance. It will, therefore, be built of gray brick, with cut-stone trimmings, and will be covered with a copper-frame, wire-glass skylight.

Contractors and Personnel

The equipment was furnished by Darling Bros., Ltd., Toronto, and consists of Canadian General Electric motors, Sundh self-starters, Yoemans pumps and Yoemans float switches.

The pumping station is being constructed by the R. Wescott Co., Ltd., contractors, of Windsor, Ont., who are doing the excavation and concrete work at actual cost plus 15%, and the installation of pumping units and other equipment at a bid price. The total estimated cost, including two pumping units and engineering and contingencies, is $18,900.

The station was designed by Willard R. Rhoads under the direction of the writer, the firm of Morris Knowles, Ltd., being the engineers for the Essex Border Utilities Commission.

"BORE FOR POWER!" SAYS SIR CHAS. PARSONS

IN an address recently delivered in London, Eng., Hon. Sir Chas. A. Parsons, inventor of the Parsons turbine, said that "failing new and unexpected discoveries in science, such as the harnessing of the latent molecular and atomic energy in matter, the great position of England cannot be maintained for an indefinite period. At some time or other, more or less remote, the population will gradually migrate to those countries where the natural sources of energy are the most abundant."

England is using up its coal more rapidly than most other countries, and Sir Charles states that long before it reaches the point of exhaustion, it may pay England to import coal from countries where it is workable at lower cost. Ultimately water-power will be more rapidly developed, although the cost of harnessing all the water-power of the world would be about £8,000,000,000.

What shall England do to be saved from the disaster threatened by the exhaustion of its coal and the competition of other lands with plenty of cheap power? Sir Chas. Parsons' advice may be summed up in the one word: "Bore." There may be cheap power waiting, ready to be tapped, down deep in the crust of the earth, he says.

He recalled that some years ago he suggested boring a shaft 12 miles deep, or about 10 times deeper than any in existence. At that time the cost was estimated at £5,000,000, and the time that would be required at 85 years! Since then, he added, experiments have been made, showing that in limestone a depth of 15 miles is probably practicable, and in granite a depth of 30 miles might be reached.

"Little is at present known of the earth's interior," said Sir Charles. "When we consider that the estimated cost of sinking a shaft to a depth of 12 miles at present-day prices is not much more than the cost of one day of the war to Great Britain alone, the expense seems trivial compared with the possible knowledge that might be gained by an investigation into this unexplored region of the earth."

In Italy, at Lardarello, he said, bore holes have been sunk which discharge large volumes of high-pressure steam, which is used to generate about 10,000 h.p. by turbines. A similar project is on foot near Naples to supply power to the great works in that district.

Without promising that a 12-mile bore hole in England would yield ready-made steam-power, Sir Chas. Parsons urged that "the whole subject merits the most careful consideration."

TEST OF RIVERDALE PUMP, TORONTO

By T. M. Jones
Chief Engineer, The Bawden Pump Co., Ltd., Toronto

THE accompanying illustration (Fig. 1) shows a recent addition made to the equipment at the Riverdale Pumping Station, Toronto. This station is at the corner of Broadview and Carlton streets, and is so situated that all the water for the east end of the city is supplied through it. The consumption of water during a period of 24 hours varies considerably, the rate of pumping sometimes being as low

FIG. 1—RIVERDALE PUMPING UNIT, TORONTO

as two million gallons per day and at other times as high as five million per day, and, as one pump is called upon to take care of the supply, the city engineer had to select a pump having characteristics that would give high efficiency at a wide range of pumpage.

Besides high efficiency, other considerations were taken into account. Due to the fact that this station is situated

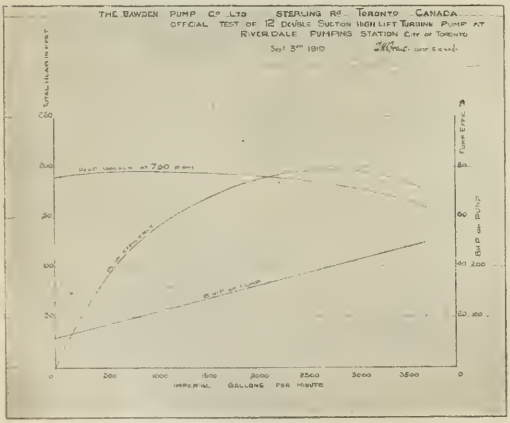

THE BAWDEN PUMP Co LTD STERLING Rd TORONTO CANADA
OFFICIAL TEST OF 12 DOUBLE SUCTION HIGH LIFT TURBINE PUMP AT
RIVERDALE PUMPING STATION City of TORONTO
Sept 5th 1919
Head in Feet
Pump Effic.
B.H.P. of Pump
Head when at 790 R.P.M.
IMPERIAL GALLONS PER MINUTE

FIG. 2—EFFICIENCY, B.H.P. AND HEAD-GALLON CURVES

in a residential section, it was essential that the pumping equipment should operate with a minimum of noise. In view of the above local conditions and the variable pumpage required, both as to capacity and head, it was necessary for the contractors, the Bawden Pump Co., Ltd., Toronto, to design a special pump having characteristics that would meet the conditions with the maximum of efficiency. After careful investigation, they decided to install a 12-in. split-casing high-lift turbine-type pump, fitted with bronze impeller and direct-connected by flexible coupling to a 260-h.p., 750-r.p.m., 4,000-volt, 3-phase, 25-cycle, wound-rotor induction motor having resistance for 50% speed reduction, continuous duty.

The pump construction is of the most modern design, having a spiral casing, and is of the double-suction type, split horizontally so that shaft and impellers as well as bearing can be removed without breaking any pipe joints.

The switchboard panel is of blue Vermont marble, mounted on pipe supports, the instruments having a dull black finish, so that all parts of the entire equipment match one another, a very pleasing feature in a power-house where neat appearance is of some consequence.

This installation was completed about two months ago, and was recently given its official tests by the city's mechanical engineer. Fig. 2 shows the pump efficiency as well as head-gallon and brake horsepower curves at maximum speed, 735 r.p.m. Tests were made at twelve other speeds with equally good results.

The flow of water was measured by a pitometer, readings being taken at five-minute intervals, and in order to obtain the average flow of water in the discharge pipe, readings were taken at every inch across the pipe diameter. The suction and discharge pressures were taken by calibrated pressure gauges. The electric readings were obtained by a specially arranged set of testing instruments. The latter were also used to check the instruments supplied with the switchboard.

FLUSHING AND CLEANING WATER MAINS*

By William Molis
Superintendent Muscatine (Iowa) Water Works

NO matter how good the water is, what the source of supply, or how good the filters operate, you will find some accumulation of some sort in water mains—mud or a trace of iron or some algia forms—depending altogether on the source of supply—whether it is a deep-seated well, a shallow well or a large or small river. While the accumulation may not be large, and not detrimental to the health or purity of the water, it still exists, and the flushing of the mains will readily remove it.

One way of doing this is to gate off a main on both sides, say for half a mile, or a few blocks at one flushing, starting at some high point in the system, either by opening hydrants or a flush gate. If no flush gate is available, then start at the high point and open hydrants down the line until you get to the end. This procedure must be followed in the cross-sections, the same as in the main lines.

This flushing process is mostly done at night, when it will inconvenience the least number of people. In the outlying districts we usually flush mains in the daytime. One must have a good force of men on the job to be ready to answer a fire alarm and to open the gates quickly.

Flushing a 16-in. or larger main is not an easy task. A goodly number of hydrants must be opened to do the work right. If there are steamer connections on the hydrants, by opening these one gets a good flow and it is easier on the pavements.

We have two flush gates in our system, one a 6-in. and the other an 8-in. opening, which open into a large sewer or creek. I would not advise emptying into a sewer that is too small; all kinds of trouble will result from overflowing into cellars.

If there should be too much deposit to wash out at one time, there will surely be some trouble with the meters, which would then have to be cleaned out after the flushing.

*Paper read before the Iowa Section of the American Water Works Association, Mason City, Iowa, October 23rd, 1919.

THE AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS

THE twenty-fifth annual convention of the American Society for Municipal Improvements will be held November 11th to 14th, inclusive, at Hotel Grunewald, New Orleans, La. Among the papers and committee reports on the program are the following:—

Tuesday Afternoon, November 11th

"The Port of New Orleans," by J. Devereaux O'Reilly, chief engineer, Board of Port Commissioners, New Orleans.

Report of committee on Fire Prevention, Alcide Chausse, chairman, Montreal, Que.

Wednesday Morning, November 12th

Report of committee on Water Works and Water Supply, George G. Earl, chairman, New Orleans.

"The Sewerage, Water and Drainage Systems of New Orleans," by George G. Earl, general superintendent, sewerage and water board, New Orleans.

Report of committee on Sewerage and Sanitation, Frederick A. Dallyn, chairman, Toronto, Ont.

"Economic Values in Sewage and Sewage Sludge," by Raymond Wells, consulting chemist, Homer, N.Y.

"The Modern Grit Chamber," by George B. Gascoigne, sanitary engineer, sub-division of Sewage Disposal, Cleveland, O.

"Brooklyn, N.Y., Sewage Treatment Station: A Brief Review of Five Years' Work," by George T. Hammon, surgeon (Reserve) U.S. Public Health Service, Brooklyn, N.Y.

"Garbage Disposal and Economic Recovery of Valuable Constituents of Municipal Waste," by Samuel A. Greeley, Pearse & Greeley, consulting engineers, Chicago, Ill.

Report of committee on Street Cleaning, Refuse Disposal and Snow Removal, George H. Norton, chairman, Buffalo, N.Y

Wednesday Evening, November 12th

"Methods of Sewage Disposal Used by the Emergency Fleet Corporation," by Clark P. Collins, senior assistant engineer, Engineering Branch of Housing Department, U.S. Shipping Board, Emergency Fleet Corporation, Philadelphia, Pa.

"The Water Supply and Sanitation of Base Section No 1 (St. Nazaire, France)," by John B. Hawley, consulting engineer, Fort Worth, Tex.

"Army Camp Utilities," by W. L. Benham, Johnson & Benham, consulting engineers, Kansas City, Mo.

"Water Supply and Sewerage Systems of Camps Meade and McClellan," by Morris Knowles and John M. Rice, chief engineer and division engineer, Morris Knowles, Inc., consulting engineers, Pittsburg, Pa.

"The Acid Process of Sewage Treatment," by Edgar S. Dorr, engineer, Sewer Service Boston, Mass.

"The Psychological Influences of Public Improvements on the Minds of the People," by P. A. McCarthy, Lufkin, Tex.

"The Proposed National Department of Public Works," by W. B. Gregory, consulting engineer, Tulane University, New Orleans, La.

"Fairness in Specifications," by Alexander Potter, consulting engineer, New York.

Thursday Morning, November 13th

Report of committee on Street Paving, Sidewalks and Street Design, W. A. Howell, chairman, Newark, N.J.

"Proper Sands and Aggregates for Cement Concrete Roads," by Duff A. Abrams, professor-in-charge of Structural Materials Research Laboratory, Lewis Institute, Chicago, Ill.

"Recent Developments in Concrete Highway Construction," by A. N. Johnson, consulting highway engineer, Portland Cement Association, Chicago, Ill.

"Mineral Aggregates for Bituminous Pavements," by Wallace L. Caldwell, director of Department of Roads and Pavements, Pittsburg Testing Laboratory, Birmingham, Ala.

"Some New Discoveries in Bituminous Pavement Construction," by A. E. Schutte, consulting chemist, Warren Bros. Co., Boston, Mass.

"Roads in France and America," by Edgar A. Kingsley, consulting engineer, San Antonio, Tex.

Report of Committee on Standard Tests for Bituminous Materials, A. H. Blanchard, chairman, Ann Arbor, Mich.

"The Economy of Brick Street and Road Construction," by Will P. Blair, vice-president, National Paving Brick Manufacturers' Association, Cleveland, O.

"Vertical Fibre Brick Pavements," by Clark R. Mandigo, consulting engineer, Western Paving Brick Manufacturers' Association, Kansas City, Mo.

"Brick vs. Block for Permanent Street Paving," by S. Cameron Corson, engineer, Norristown, Pa.

Thursday Evening, November 13th

Report of committee on Street Lighting, C. W. Koiner, chairman, Pasadena, Cal.

"Illuminations, Ancient and Modern, with Special Reference to Decorative Street Lighting," by W. D'A. Ryan, director of General Electric Illuminating Engineering Laboratory, Schenectady, N.Y.

"Public Ownership of Utilities in Springfield," by Willis J. Spaulding, commissioner of Public Property, Springfield, Ill.

Reports of committees on Standard Specifications: Sheet Asphalt Pavement, Francis P. Smith, chairman, New York; Bituminous Macadam, Bituminous Concrete and Asphalt Block Pavements, Morris R. Sherrerd, chairman, Newark, N.J.; Broken Stone and Gravel Roads, With or Without Bituminous Surface Treatment, Arthur H. Blanchard, chairman, Ann Arbor, Mich.; Brick Pavements, E. H. Christ, chairman, Grand Rapids, Mich.; Cement Concrete Pavements, William A. Hansell, Jr., chairman, Atlanta, Ga.; Stone Block Pavements, H. H. Smith, chairman, Brooklyn, N.Y.; Wood Block Pavements, E. R. Dutton, chairman, Minneapolis, Minn.; Sidewalks and Curbs, Sylverius Sammelman, chairman, St. Louis, Mo.; Sewers, Alexander Potter, chairman, New York City; Foundations for Pavements, special committee, F. P. Smith, acting chairman.

Friday Morning, November 14th

Report of committee on Traffic and Transportation, on Uniform Traffic Laws and Classification of Highways, R. Keith Compton, chairman, Baltimore, Md.

"A National Highway System and Its Relation to Traffic and Transportation," by S. M. Williams, chairman, Highways Industries Association, and Federal Highway Council, Washington, D.C.

"Highway Traffic," by Frederic A. Reimer, county engineer, Newark, N.J.

Report of committee on City Planning, Nelson P. Lewis, chairman, New York.

Regional and Civic Planning as the Basis for Municipal Improvements," by Thomas Adams, housing and town planning adviser, Commission of Conservation, Ottawa, Ont.

"Lowland Farms Development, Youngstown, O.," by Morris Knowles, John M. Rice and E. O. Rose, Pittsburg, Pa.

"Architectural Design and Construction in St. Louis Parks," by Nelson Cunliff, commissioner of Parks and Recreation, St. Louis, Mo.

"The phenomenal development of highway transportation in the United States has created a demand for men having knowledge of and trained in a new technical field, which may be designated Highway Transport Engineering. Fundamentally, this branch of engineering deals with the science, art, economics and business of highway transportation of passengers and commodities. During the past decade, the United States has witnessed a rapid growth in the utilization of the motor vehicle as indicated by a registration of 125,000 motor vehicles in 1908 and 6,146,617 in 1918. While in 1908, a motor truck was rarely seen on American highways, in 1918 not less than 600,000 were in use in the United States, motor trucks constituting from ten to twenty per cent. of the registered motor vehicles in the several states."—A. H. Blanchard, Professor of Highway Engineering, University of Michigan, Ann Arbor, Mich.

THE UTILIZATION OF SEWAGE SLUDGE*

By John D. Watson
Birmingham, Eng.

REAL progress in the treatment of sewage sludge was made in Birmingham when it was first realized that (a) sewage was inoffensive to the sense of smell until putrefactive changes began, and (b) that foul-smelling sludge ceased to offend the olfactory nerves when putrefactive changes had run their course.

To bury sludge as it leaves the sedimentation tanks is to take the most efficient method of retaining the foul odor which characterized it when it left the tank. Sludge was unearthed at Saltley recently after 30 years, which proved that burial *per se*, even if the sludge is deposited near the surface of the ground, where nitrifying organisms are most active, is not sufficient to free it from objectionable smell.

With the idea of carrying on the functions of oxidizing the liquid of sewage and the septicization of sludge simultaneously, Dr. Imhoff patented about 1904, and in German fashion boomed, a two-story tank, which had the Travis hydrolytic tank for its prototype. The lower chamber of this tank is for fermentation, and the upper one for sedimentation. The Birmingham plan provides two separate shallow tanks, one placed alongside the other, to do the same work.

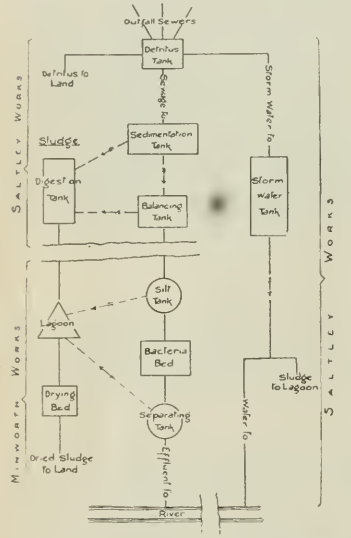


FIG. 1—DIAGRAM ILLUSTRATING METHOD OF PURIFYING BIRMINGHAM SEWAGE

In comparing the two, it is claimed for the Birmingham method that the cost of construction is less; it is better under control; the results obtained under normal conditions equally good, and under abnormal conditions—such as obtain in time of rainfall—much better. Operating costs of the Birmingham method are greater than by the Imhoff method, but the latter is distinctly inferior when large quantities of antiseptic substances like gas tar, arrive unheralded at the outfall works. It is desirable to isolate highly antiseptic matter instead of automatically distributing it over the whole surface of the fermentation chamber, or lower story of the Imhoff tank, where it tends to inhibit the action of the anaërobic organisms upon which the success of the process depends.

There are no doubt advantages and disadvantages based upon physical and topographical circumstances pertaining to both methods which an engineer must appraise in determining the design most suited to individual cases, but the author maintains that the shallow flat tank has more to commend it than the other, and in this view he is supported by the Drainage Board's consulting chemist, F. R. O'Shaughnessy, whose knowledge of this process is unsurpassed.

A marked feature of the Birmingham installation is the temporary character of the sludge digestion tanks, many of which are formed by a combination of excavation and embankment; the material employed to make the latter is composed chiefly of engine ashes laid on the soft material from the excavation. No lining of flag-stones or inside coating of any kind is given to these improvised tanks, the sludge itself having been sufficient to seal all the interstices of the ash embankments. These tanks or lagoons are sufficient to effect the main objects in view, but they do not admit of the advantages of quick and thorough emptying and refilling associated with well-built vertical-sided tanks. Still, when cheapness of construction is essential, as, for instance, when

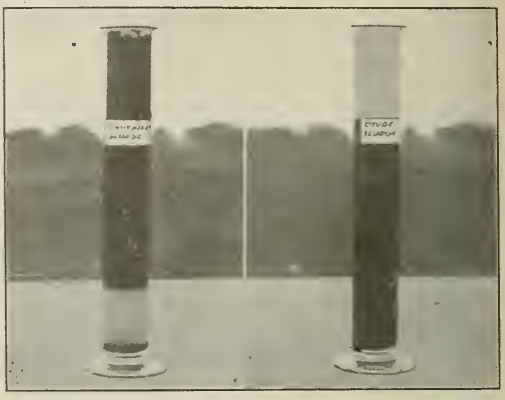


FIG. 2—FERMENTED SLUDGE FIG. 3—CRUDE SLUDGE

one is experimenting, this form of construction has much to commend it; indeed, if the Birmingham installation had had to be designed with the view of obtaining Local Government Board sanction to a loan, the probability is that it would never have been built, and the gigantic experiment which is about to be described would never have been made.

After the inflowing sewage from a population of about 750,000 persons passes through the detritus pit, from which the heavy solids are dredged by an electrically operated dredger, it flows through five sedimentation tanks working

FIG. 4—DRYING BEDS, SHOWING METHOD OF DRAINING

in parallel and subsequently through what is called a balancing tank. (See Fig. 1.) Each of the former has a capacity of slightly more than 1,000,000 gals., and the latter 7,000,000 gals., together 12,500,000 gals., or about half the dry-weather flow coming to this, the main outfall of the Drainage Board's Main Sewerage District. Each of the 5,000,000-gal. sedimentation tanks is cleaned every week, and the balancing tank, which is run in series with them, less frequently.

*Paper presented at the 46th annual meeting of the Institution of Municipal and County Engineers of Great Britain.

The crude sludge—92.5% water—arrested in the Saltley sedimentation tanks alone amounted to 1,523,000 cu. yds. during the past four years, or an average of 380,750 cu. yds. per annum, the whole of which was transferred to 39 sludge digestion tanks or lagoons possessing a total capacity equal to 28,250,000 gals.

The total *dry solid matter* removed from all tanks at Saltley, etc., Outfalls, including Minworth Tanks, in the four years 1915-18, amounted to 110,000 tons, or 75 tons per diem, all of which was transferred to the sludge digestion lagoons.

The density of the sludge removed chiefly depends on the frequency of the cleaning operation. During 1915 these tanks were emptied once in two or three weeks, when the average water content of the sludge was 87%, whereas the weekly cleaning during the four years under consideration yielded sludge with a water content of about 92.5%.

Theoretically, the more frequent the emptying operations the better, but economy suggests a curtailment of the operation when temperatures are low. When temperatures are high, there should be frequent cleaning, and the strictest avoidance of obstructions in the sewers should be encouraged if objectionable odor is to be reduced to a minimum. This becomes even more imperative as the area of a drainage district increases.

It has been shown that with care the putrefaction of the liquid can be prevented, but the successful digestion of the sludge has proved to be a more difficult problem; still, with accumulated experience and the expansion of the tank area, the operations at Birmingham have been conducted with greater ease, economy and success as time went on.

The digestion tanks used at first consisted of an existing installation of 20 tanks, 16 of them with an aggregate capacity of 4,539,500 gals., and 4 of them with an aggregate capacity of 2,723,680 gals., all so thoroughly well built and equipped with emptying arrangements that they are easily the best of the installation of 39 tanks.

For the first two years the digestion operations were conducted in two stages in this installation of 20 tanks. The 16 tanks were used for primary digestion and the 4 larger ones for the secondary digestion. Two stages were adopted, as it was found in the very early days that vigorous fermentation was the better maintained thereby and tank space was saved to such an extent by pumping from one tank to another that the second pumping was economical when compared with the prospect of an increased capacity; it was soon discovered also that inoculating raw sludge with ripe sludge thus obtained from the secondary tanks had an excellent effect upon the "speeding-up" process. Further, temperature was too obviously a beneficial factor in the success of the process to be ignored.

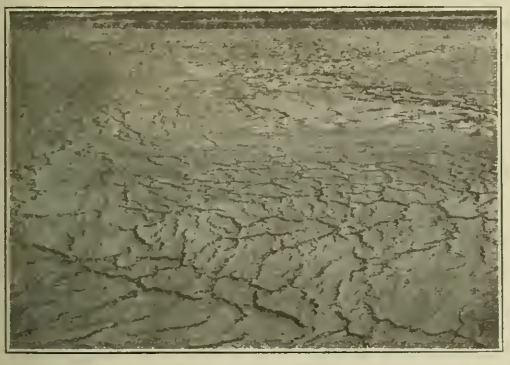


FIG. 5—SLUDGE AFTER IT HAS BEEN IN THE DRYING BED FOR THREE DAYS

The following mode of operation was adopted at the beginning of 1912 and has been continued ever since:—

In cold weather the sludge is transferred from the particular sedimentation tank whose turn it is to be cleaned out, into the selected digestion tanks (generally five or six in number) by the main set of pumps; simultaneously some of the ripest of the available sludge is pumped by a small pump into the same delivery main in the proportion of 1 to 4, thus inoculating at the earliest possible moment the fresh sludge with the fermentative organisms; in addition, steam from one of the Lancashire boilers is injected into the delivery main to produce temperature conditions most favorable to fermentation.

In moderately warm weather steam injection is abandoned, and during the heat of summer neither inoculation nor steam injection are resorted to. The biological factor governing the digestion process must necessarily be somewhat complicated, and it is only by the most careful observation of the conditions which bring about the right balance of living organisms that success can be achieved.

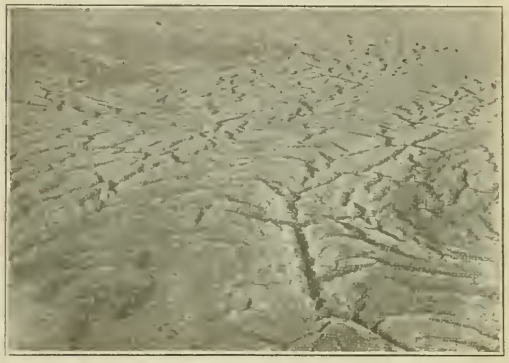


FIG. 6—SLUDGE AFTER IT HAS BEEN IN THE DRYING BED FOR THIRTEEN DAYS

The following tables of analyses supplied by Mr. O'Shaughnessy indicate two different sets of conditions, Table A where the fermenting mass was very offensive, and Table B where the vigorous fermenting mass was quite inoffensive:—

TABLE A.

		Total counts. Organisms per cc.
Gelatin-Peptone-Bouillon at 20°C.	Mean	24,000
Agar-Peptone-Bouillon at 37°C.	"	130,000,000
Coli group		7,000
Proteus group (including *Enteritidis sporogenes*)		100,000
Denitrifiers		500
Fat-splitting organisms		10,000
Cellulose		100,000

TABLE B.

	Total counts. Aërobic per cc.	Anaërobic per cc.
G.P.B. at 20°C.	52,000,000	15,700,000
A.P.B. at 37°C.	5,000,000	3,000,000
Coli group	60,000	
Proteus group	100,000 at least	
Denitrifiers	100,000 "	
Fat-splitting organisms	100,000 "	
Cellulose organisms	50,000	

Having obtained the right bacterial balance, so to speak, the aim of the management is to maintain it. What looks like an inexhaustible volume of sludge which constantly varies in character (about 1,000 tons per day) is drawn to a locality literally surrounded with dwelling-houses, factories, etc., and formerly gave rise to loud and serious complaints. Now, this large mass of foul material is treated on the same site without any offence whatever.

Variation in the character of sludge is only to be looked for in a great manufacturing district where there are no restrictions on the discharge of trade waste into sewers; but these are sometimes very serious in their consequences, as when large discharges of tarry products from coal, water, or producer gas-plants suddenly appear.

The saving factor in the situation is the system of separate sedimentation and separate sludge-digestion tanks, so that whether it is a sudden increase of volume due to rainfall or an overpowering mixture of antiseptics, the large number of sludge tanks in all states of fermentation renders the scheme at once elastic and manageable. The capacity of the whole of the sludge-digestion apparatus is equal to 165,000 cu. yds., or 28,000,000 gals., which, with the present demand, means a time retention of between four and five months.

FIG. 7—FIVE TIP WAGONS DRAWN BY ELECTRIC BATTERY LOCOMOTIVE

The average analysis of the sludge for the four years 1915-18 is as follows:—

Water	92.5	%
Dry solid matter	7.5	%
Specific gravity of wet sludge (estimated)	1.0256	%
Specific gravity dry solid matter	1.50	%

The average analysis of the dry solid matter is as follows:—

Matter volatile at red heat	58.5	%
Matter non-volatile	41.5	%
Total nitrogen	2.71	%

The fatty matter in the crude sludge varies greatly, the actual limits for the figures in the analyses made being from 16.86% to 31%, with an average of 22%. These figures represent a total ether extract, but it is probable that about 2% of this ether extract is resinous matter, and the real fatty matter will be represented by an average figure of about 20%.

Those who see the Birmingham works for the first time are struck by the great distance (about five miles) which separates the sedimentation tanks from the bacteria and sludge-drying beds. In contemplating this it should be remembered that the Saltley section of the Board's works was built more than 60 years ago.

The author is responsible for selecting Minworth as the site of the main works, and the reasons were:—

1. The advisability of obtaining as isolated a site as possible where it would be practicable to have the whole of the works some day.

2. The belief which obtained 20 years ago that a 24-hr. period of septic action was beneficial, and that utilizing the capacity of the existing 8-ft. conduit (6,000,000 gals.) would obviate the need for increasing the tank capacity at Saltley.

3. The fact that the disparity between the falling gradient of the conduit, 2 ft. per mile, and the river, 7½ ft. per mile, provided an available head of 29 ft. with which to spray the sewage over the bacteria beds and eject the sludge from the silt tanks.

Minworth was also selected as the best site for completing the fermentation process of sludge treatment and laying out the drying beds. This involved pumping from Saltley, a distance of five miles—a task which looked more formidable than it turned out to be, the sludge in its fermented state having been found to be more mobile than was expected, a condition due probably to the innumerable air-bubbles between particles acting upon it as so many ball-bearings. This is illustrated to some extent by the photograph of the glass cylinder (Fig. 2), which shows fermented sludge, after a short settlement, held up by the air-globules *above* the clear water. Fig. 3 shows the crude unfermented sludge in a similar glass cylinder with the liquid above the solids.

The improvised lagoons at Minworth, which form part of the installation of 39 tanks, were formed by surplus spoil from the bacteria bed site and dry sludge from the drying bed area, and they perform at least three functions:—

(a) They give time for the completion of the fermentation process.

(b) They permit, with almost no detriment to the installation, the admission of humus from the bacteria beds, flushings from tanks and flushings from distributing pipes.

(c) They act as decanters of supernatant water.

The first is of course the primary purpose of the lagoon.

Imhoff found that he required his fermentation chambers to be large enough to contain from three to six months' storage of sludge. The author finds that the average requirement for the past four years has been equal to a storage of four months.

It has been proved abundantly that sludge dries more readily when the digestive process has been carried to exhaustion before it is pumped to the drying area; hence the economy of ample tankage.

The second is a most important function. The so-called "humus" excreted from a bacteria bed, like the sludge discharged from an activated sludge plant, is a valuable fertilizer, but so far has not been utilized because of its "emulsive" character and the difficulty and expense of dewatering.

FIG. 8—FILLING WAGONS WITH DRY SLUDGE

When nearly 1,000 tons of it have to be got rid of each day, the importance of dewatering cannot be over-estimated. To pump it back to the beginning of the process (the detritus pit) is a practicable solution in most cases, but not when it has to be forced through five miles of pumping main. Mixing it with the sewage as it entered the silt tanks just before spraying it over the bacteria beds was tried, but was found impracticable owing to the fibrous growths which were introduced into the distributors. Allotting a lagoon to itself with the view of trying to separate solids from liquids

(Continued on page 427)

RECONSTRUCTION AND CIVIC DEVELOPMENT*

What We Have Learned from the War and What We Can Take from Europe—"Co-operation" the Slogan for the Reconstruction Period

By C. H. Mitchell, c.b., c.m.g., d.s.o.
Dean of the Faculty of Applied Science and Engineering, University of Toronto

We have learned a great deal by the war. We have learned a great deal in adjusting our ideas so that on coming back home we may reapply them in Canada. We who are engaged in construction, whether material or educative or moral, are confronted with many problems, and what our soldiers have learned in Europe can readily be applied here, to the best advantage, to the new conditions under which we now find ourselves.

For those of us who are engaged in construction and in art, civic development, town planning, architecture, etc., what more do we want in the way of inspiration than some of the things that all of us saw, for instance, in that sacred city of Ypres, with its wonderful architecture, its features of what old-world planning meant 400 years ago, and, by contrast, what it may mean now: the beautiful architecture of the Cloth Hall and St. Martin's Cathedral, and the old walls and the moat, the wonderful old gates, the Menin Gate and the Lille Gate. All these things must have an influence on those who have come back.

Impressions from Italy

In the same way, in my own experience, I cannot help feeling that my year and some months in Italy were full of memories which will influence my life and views for many years to come. When we first went to Italy, now almost two years ago, we were confronted with many problems in which civic development and town planning had a very material part. The little city of Mantua, which you all know from Shakespeare if in no other way, had, to me at any rate, a particular interest because of the extraordinary arterial traffic arrangements in narrow, crowded streets, with arcades along them, and in which the traffic conditions were very serious.

No one would ever have thought of them as being serious if we had not tried to march one division after another toward the front, through those narrow streets. I shall never forget the day when the First British Division marched through Mantua, going toward the front, November 19th, two years ago, when the enthusiasm of the Italians knew no bounds. Brigade after brigade of infantry and artillery and transport marched through that little old city, with its narrow streets resounding with the clank of wheels, and the whole populace out on the streets or wherever they could get—on the verandas or on the galleries or in the windows—shouting, cheering, singing, waving everything from handkerchiefs to table cloths, and throwing flowers and fruit to the soldiers continuously for hours at a time. It was a wonderfully inspiring thing, and that same spirit followed the British all through that campaign to the end, and when we came out of Italy the Italians were the same firm friends of the British that they had always been.

An Axiom and an Example

And Venice! I well remember standing in Venice a year ago, after the armistice, and comparing Venice then with the Venice of 12 years ago, when I saw it before, and trying to realize what the war had meant to that city. Venice was not close enough to the front, even after the terrible catastrophe of Caporetto, to be shelled, although a few shells were dropped near it; but it was close enough to the front to be almost continuously bombed by the Austrian airmen.

It is surprising how many bombs can be dropped into a city without doing much damage, and it is surprising how little damage of a serious character really was done. You will all be glad to know that the damage to Venice was comparatively small.

With regard to the war generally, we have been in the business of destruction, and now we are confronted with the business of reconstruction, and with that goes all the development that we have learned from Europe. But the situation and the conditions in which we have to apply this, determine the progress that we can make. That is another axiom, of course, which is ever before those engaged in civic development and town planning. But of those things, what are we going to select? Along what lines are we going to develop? I cannot refrain from quoting a thing written by Kipling,

> "When 'Omer smote his bloomin' lyre
> "He'd 'eard men sing by land and sea,
> "And what he thought he might require
> "He went and took, the same as me."

Now it is for us to go and take, and what we can take and apply in Canada are the things with which we are most vitally concerned to-day.

What Can We Take?

What can we take? The science and the art of town planning—I am speaking now in the broadest sense, and it is not confined to town planning but applies to civic development, and national development if you like—is based on three principal things. The first is the collection and the investigation of information and data. After all, I suppose that is the same kind of job as I had in the war, which was the collection of information, only it was about the enemy. I feel strangely familiar with those expressions. Next after that comes the analysis of that information; and after all, I suppose that is a bit of intelligence work too. And thirdly, the conclusions we make from that analysis, and their application. Those are the things with which we are now concerned.

In general, there are two large branches into which these resolve. One is the branch of education, the informing of the public as well as ourselves, and the improvement of our minds, with regard to the science and the art of civic development, based upon all those things which we have brought from Europe and of which we have read. Then comes, arising from that, the application: The legislation, which, through the means of good government, we are able to bring about, by that means forming a stimulus by which to raise the standards of life.

Roads and Transportation

Let us see what, of these things which we have been able to learn from the war, we may apply in this country. Take, for instance, the question of roads and streets. I do not want to be too specific, but those of us who have been "over there" realize what good roads and streets, the proper kinds of streets for definite purposes, mean. Those of us who were driven along the great pavé roads of northern France, realized then, and we realize more now, when we have come back to this country, what Napoleon meant when he said that roads won wars. I do not suppose there has ever been a finer example of that axiom than in this war, for I am sure, as you must have heard dozens and dozens of times, that the war could not have been fought in Flanders were it not for the good pavé roads that Napoleon's engineers built 100 years ago. Not that we anticipate ever having a war in this country, but we are engaged in a war of peace, a war of industry and a war of many other things, by contrast, which require good roads. Now let us start out to get good roads and good streets built for the purpose.

Another phase is transportation as apart from the material road itself. When I got back to Canada, landed at Montreal and a few days later arrived at Toronto, I was struck with the tremendous change that had come about in our civic situation by the very general use of the motor car. We thought, over in France, and in Italy, too, that we had nearly all the motor cars of every kind and vintage that could be scraped together into one place. When we got back to England, on leave or after the war was finished, we dis-

*Excerpts from a luncheon address before the Canadian Club of Ottawa, Ont., during the joint conference held October 18th-19th by the Town Planning Institute of Canada, and the American City Planning Institute.

covered, as we thought, that probably most of the cars came from there, because there were comparatively few in England. But when we got back to Canada and saw them parked for miles on the streets of Montreal and Toronto, we realized that, after all, all the motor cars in the world had not been sent to the war; and we realized also what it means to introduce a new form of transportation that is going to revolutionize the whole business of civics.

Aeroplane Photography

A means of study which the war has developed, and which perhaps we who are engaged in civics and in other lines of work can naturally use to good advantage now, is aeroplane photography. I saw hundreds of photographs of towns in France and Belgium, and in Italy, too, not only on our own side—we took very few, of course, on our own side—but also on the side occupied by the enemy, and I could not but realize what a great advantage it is to have the means of getting an aeroplane photograph of a place in order to pick out the essential, outstanding features. It seems to me that if I were a gentleman engaged in town planning, I would want to own an aeroplane in order to take photographs before and after, and in order to make studies of how to replan and how to work out schemes.

You probably remember the use to which aeroplane photography was put recently in connection with excavations in Persia, and which someone out there discovered, I suppose, by accident. Some persons who were looking for the ruins of a lost city were able by an aeroplane photograph, taken high up, to discern underneath the sands, by some difference of color or shading, or some features about the sands, the outlines of the city for which they were seeking,—by the same method by which an aeroplane or a balloon can always see a submarine deep down in the water. It is a most curious application of aeroplane photography, but I am sure of this, that many other things will be found about this device which can be applied to much of our work in the future.

One of the first requisites in our reconstruction is education. Not only in the science and art of town planning and civic development, but in many other things, our country requires education: that publicity which comes through the press and otherwise; that real, genuine, basic information which comes through the school children themselves in the public schools, and which, as many of you know, is being applied with such great success in Chicago; and the education in connection with our universities.

Four Hundred Freshmen

The Faculty of Applied Science at the University of Toronto now has many more students than in the greatest year before the war. There are over 800 students, of whom 400 are freshmen. As announced yesterday, we are hoping to put on a course, and some work in design, etc., in connection with civics and town planning, and that, we hope, will be something towards education for the country in connection with this work.

In Canada, and in fact all over this continent, we have come now to the industrial age, and with industry, as we see it now, and as we saw it during the war, the great essential is to produce. To produce more we must introduce methods and means whereby the people can live more comfortably and earn their money more easily, and go back and forth to and from their work more readily, particularly as industries are developing far out from the crowded portions of the cities. And at the same time, we must realize that our duty is to do something by which the earnings can be more equitably distributed for the convenience of everyone. That I do not wish to discuss further except to say that we should realize that the industrial situation is closely bound up with general civic development and the broad subject of city and town planning.

If we look at the great successes of industry and science, not only during the war, but for centuries before, we find that they are the evolution of many minds, the evolution of many years, the evolution of many processes and experiments, some of which have been great failures, others of which have been successful in the sequence by which they have come. To them we look for examples by which we can apply our future methods of civic development and our future methods of civic planning. I am speaking now not only of the actual planning, but of the economic side and of government as well.

The methods by which this can ultimately be brought about will be identical with the methods by which the evolution of anything in history has been achieved, such as the steam engine, or such as, in the war, the tank. A few weeks ago an effort was made to determine who invented the tank. Well, of course, no one man invented it. Eleven claimants came forward to the Inventions Board to say that they had invented it, and the next day, not after a long period of investigation, it was discovered, and announced by Winston Churchill, that no one man invented it; that to the whole eleven belonged the glory of the achievement. And the same thing is going to apply in civic development and civic planning of all kinds. Everybody is in it and everybody is doing it, and the thing is to have it go hand in glove with all the other development and reconstruction work in which we in this country are embarked.

The Scientist Comes First

And in that development the scientist must be the first man to do his part—to do the part which will bring about the analysis and the investigation of all these things, and the first trials which are made; and after that, so far as town planning is concerned, the aesthetic side, the artistic side, comes into consideration. But do not let us try, as I fear we in Toronto for a long time tried, to have the artist the first on the ground, and then to consider the practical or the scientific side in the second place. It should be the other way round.

With regard to legislation, just a word. That is the other element with which we have to deal, and which, I am sure, everyone is thinking about a great deal at the present time. The duty of those responsible for legislation is primarily to raise the standards of human life. I think everybody will agree to that. And whatever we do for reconstruction, that must be the thing in front of us, clearly defined all the time; to make the country a better place in which to live and work; to make the lot of those who work, happier and more contented—because you cannot get really good work out of discontented people, and with discontented people you cannot get health and ease. Lloyd George once said: "You cannot make an A1 nation out of a C3 lot of people." That applies just as much now, when we are at peace, as it did when we were at war. Now we have come to the period when legislation is required; more legislation; not too much of it. I am afraid we have too much of it now in some respects.

Another thing which Lloyd George said:—"Society and the nation at large, at the present time, is in the molten state, and in that molten state you can impress or stamp anything on it that you will, so long as it is reasonable." Now is the time to put the stamp on it, and let us do so in civic development.

Education, Legislation and Co-operation

Following on these two, education on the one hand, legislation on the other, comes the other thing, co-operation. Co-operation won the war, and we cannot say it too loudly in this country at the present time. Those of us who were at the front know what co-operation meant among the various arms of the service. Those of the infantry know what it meant to have co-operation from the artillery, shooting over them, carrying them, with its barrage in front of them, up to the enemy's position. Infantry and artillery both know what it meant to have the co-operation of the engineers, who were preparing in various ways to help them across. They all realized what it meant to have the co-operation of the men in the air, who were observing for them, directing operations so far as information was concerned, and performing all the work which men in the air could do. And behind it all there was the co-operation of all the various organizations and the staffs all the way back to the army staff, 20 miles behind the line. That was co-operation, and it all fitted into one plan; and the more we worked at it, the more we tried, the more we developed it and the better the co-operation, the better we succeeded and the more we won.

Now we have come back to the wars of peace, and co-operation is the watchword. We must have co-operation from everybody in the scheme of the country, from the top down, from inside and out, from all classes of people—everybody trying to help everybody else; and in no place can we apply it more advantageously and more successfully than in this very large problem of civic development. I am sure that in the construction period that we are entering on now, with the public mind not settled on these things, the leaders of all civic improvement and civic development must take their position to lead and to impress and to engage in that co-operation all classes of people.

People say right away, if we start talking about large programs—and I am afraid that very large programs are talked of—that money is the first requirement. Well, money may be; but there are many things that can be done even without a large amount of money, and it is for those of us engaged in this work to think out what we can do, for the present at any rate, until such time as money is forthcoming to do it, and therein to adjust our views to the requirements of the country for the future. But again it is co-operation.

In the same way, policies of all kinds are advanced—good and bad, reasonable and unreasonable—policies which are nebulous and policies which are perhaps too specific; but all of these require careful thought and discussion and education and publicity, and the co-operation of everybody, from the top down, in order that we may determine what policy to follow. And in the end, everything from the group to the community, and the regional area, and the nation, and all things which involve housing, transportation, public utilities, education, etc.—all of these things fit together, so that in a large way the word "co-operation" spells success. The great motto, after the war and for the period of reconstruction, is "co-operation."

PRESSURES IN PENSTOCKS CAUSED BY THE GRADUAL CLOSING OF TURBINE GATES*

By J. T. Noble Anderson

On several occasions, the writer has investigated this question, or a cognate phenomenon, with pumps—centrifugal and others—through long pipes. In one case, there were two pipes with a common penstock—each of wood, 3 ft. in diameter, and 2,300 ft. long. In every case, he has been greatly impressed by the extreme complexity of the subject.

With the help of Prof. Joukovsky's theory and some "rule-of-thumb" guesses, gained from a general experience, these pipe lines and the values concerned can now be calculated to as close an economic margin as most other engineering problems. At the same time, the result of experience shows so many baffling discrepancies, that the experimental results, which Mr. Gibson hopes to obtain "in the not too distant future," will be waited for eagerly.

The care he has taken to collect and co-ordinate the formulas, is an earnest that he may be relied on to record fairly and fully not only his results, but all the extraneous facts and happenings which may, however, remotely, bear on the many irregularities between actual records and what the formulas anticipate. In particular, it might help if two slightly disturbing factors were recorded in each test, that is: (1) The temperature of the water; and (2) the proportion of free air present in the water.

The second factor will probably be quite immaterial, but, in a case where the substance pumped through a centrifugal was sewage with a specific gravity of 64 lbs. per cu. ft., the author found that the gases contained had a very disturbing influence.

In some recent investigations, the writer used a steam indicator with springs specially chosen for the anticipated pressure. Some indication of Mr. Gibson's apparatus will no doubt be given.

*Discussion (presented to the American Society of Civil Engineers) of Norman R. Gibson's paper (see September 4th and 11th issues of *The Canadian Engineer*).

LOT AND BLOCK UNITS FOR HOMES OF MODERATE PRICE*

By Arthur Coleman Comey
City Planner, Cambridge, Mass.

It is to be assumed that in the normal case a proper layout of main streets and disposition of public grounds will permit the minor streets to be so arranged as to produce the optimum in block lengths and widths, the latter closely affecting lot depths. Lot widths on the other hand are not controlled to any large degree by other elements in the plan and may, of course, readily be changed at any subsequent time prior to development or actual sales without materially modifying its general relations.

Factors Controlling Width

The factors controlling the width of interior lots are, on the one hand, adequate width for the dwelling itself, light and air in its yards and (to a less degree) passage for automobiles; on the other, the cost of utilities in the street, which rise rapidly as lot widths are increased and practically require the minimum adequate width to be the standard, if not the maximum as well, except as topography and other elements in the plan fix certain points and permit somewhat larger lots without increased expense. A house nearly square is the most economical, so that, except where under the spur of high land values lots have been plotted too narrow, the two room deep house is the usual type.

For detached houses, 7 or 8 ft. is the minimum side yard width to assure sufficient light and air at the first story, as well as safety from fire. One side yard should be at least 10 ft. wide to provide space to drive an automobile. The square house is probably the widest that should normally be provided for. The 6-room house may be as small as 22 ft. square, the 7 and 8-room types running up to 26 or 27 ft. The proper standard minimum lot width for detached houses is 40 to 44 ft. Unless 40 ft. can be obtained, semi-detached or row houses should be planned.

For semi-detached houses, 10 ft. is none too wide a side yard for light and air as well as for the passage of automobiles. Such houses need not be over 23 ft. wide and are frequently not over 20 ft. The proper standard minimum lot width for semi-detached houses is 30 to 33 ft. In sections with moderate rentals it is proper to mix detached and semi-detached houses according to any scheme of grouping the city planner and architect may work out. Each pair of semi-detached houses requires 1½ lots of a size suitable for detached houses. In cases, therefore, where it is desirable to plat lots in advance of building, the 40-ft. width, or better, 44 ft., may be used as a standard minimum.

Mingling of Types Undesirable

Three reasons prevent the advantageous mingling of row houses with the other two types: An alley is usually required behind the row house, a considerable expense, which constitutes an unnecessary burden if incurred behind houses with side yards and therefore not dependent on alleys; the larger building units are apt to be out of scale with the other types; and in most cases the type of occupancy is different. The row of three houses placed at intersecting streets may be used with semi-detached and detached houses by adding to the rear yard of the middle house an extension 10 to 20 ft. wide, reaching the side street across the rear of the corner lot. The unit of three will require about two lots of the size for detached houses, and therefore fits into a scheme of 40 to 44-ft. lots.

The row house attains practically its full economy with 5, 6 or 7 in a group. Above 9 the inordinate length of the row becomes unpleasant architecturally, and at the same time increases fire risk and steadily decreases ventilation in the block. Such relatively short groups obviously require special lotting. The lot widths for interior houses are controlled absolutely by the design of the house. To secure

*Paper read October 19th in Ottawa, Ont., at the joint meeting of the Town Planning Institute of Canada and the American City Planning Institute.

adequate light and air, row houses should not be more than two rooms deep. The usual plan is one large room across the front and one or two smaller rooms at the back. The proper width for such a house is 18 or 20 ft. The end houses of rows may be put on lots 27 to 30 ft. wide, so that two such end houses of adjacent groups require three of the lots designed for interior houses.

It is difficult to make a lotting scheme which will serve for both row houses and for semi-detached and detached houses. In cases where row houses are anticipated, lotting should accompany the plan for grouping the dwellings instead of preceding it.

Expense is in Frontage

While it is generally recognized that 50 ft. is sufficient distance for light and air between the fronts of small houses, and while this same distance is also a sufficient minimum between backs, in practise such shallow lots as these dimensions produce are seldom found necessary owing to the fact that added lot depth does not correspondingly increase the cost of most utilities. It is frontage that is expensive, and rear land must be considered to remain close to the acreage cost of raw land. This is a particularly important factor where topographical conditions or irregular boundaries would involve considerable extra length of streets to produce but few more lots of standard depth, the alternative of fewer and deeper lots with much less street construction being much cheaper and involving only a slight loss in gross selling value.

On all except the main thoroughfares, the needs of traffic are not sufficient to affect the distance between the fronts of houses. In detached house neighborhoods, experience indicates that 20-ft. front yards are not excessive. For semi-detached houses, 15 ft. is found suitable. For row houses, 10 to 15 ft. may usually be provided. A variation in set back not exceeding 5 ft. usually adds to the attractiveness of the street. Unnecessary depth runs up the cost of service lines from the utilities that are placed in the street. If the street line were placed at the building line, as in Washington, D.C., the utility lines might be run close to the houses, thereby saving considerable expenditure necessary under any of the present methods.

Houses of moderate price normally range from 18 to 32 ft. in depth, the vast majority being from 20 to 30 ft. deep, though certain designs for narrow semi-detached houses may require 34 to 35 ft. In the depth of rear yards even more variation occurs, both because their use varies and because it frequently proves to add so little to the cost to make them ample. For detached houses, an ample garden space for a person working elsewhere during the day is 40 by 50 ft. If not so used, this is still not too large for children's play.

On streets of ordinary width, lots for detached houses should normally be planned 90 to 110 ft. deep; for semi-detached houses, 80 to 100 ft.; and for row houses, 70 to 90 ft., including to the centre of alleys where introduced.

Where extreme land values do not preclude, a scheme of lots based on a standard minimum of 40 to 44 ft. by 90 to 100 ft. is proper. In extreme cases, where row houses are certain to come, lots as small as 16 to 18 ft. by 70 ft. may be necessary, but intermediate widths so common in most of our cities are not easily adapted to modern housing standards.

Corners are Special Problems

The best size for corner lots in cases where practically all the houses are to face one set of roughly parallel streets may be fixed as ranging from the same width to 5 ft. wider than corresponding interior lots, and approximately the same depth.

With houses fronting on all streets, to secure the maximum salable frontage and the least interruption to the architectural motive along each street and around the corner, the corner lot is best made approximately square. It should be equal in area to the corresponding interior lots. A somewhat large square corner lot may be cut diagonally in two, and a pair of semi-detached houses set across it, though this expedient is not always pleasant. It is not apt to be a good plan to attempt to crowd houses at a street intersection and still give sufficient square feet of rear yard space by violent skewing or irregularity in lot boundaries. Acute interior lot corners should be particularly avoided. Lot lines should usually be run back at least 40 ft. to a point not less than 5 ft. behind the house, approximately at right angles to the street.

Block widths are normally twice lot depths, though many irregular blocks are bound to be platted, especially in layouts on rough or peculiarly shaped land, to economize in construction cost and in land used for streets.

Block lengths are controlled by the needs of traffic, both vehicular and pedestrian, and by factors of safety. Experience shows that in residential areas, blocks 600 to 700 ft. long cause little dissatisfaction. Shorter blocks are wasteful of land in cross streets. Blocks longer than 800 ft. are found to cause undue detours in going from one side to the other. This is more noticeable in the case of foot traffic than the modern automobile. Inasmuch as adequate footways require but one-sixth the space of cross streets, and even less proportionate construction cost, their use midway across blocks of lengths up to 1,200 ft. is permissible, particularly in districts with steep slopes, making connecting streets expensive. In areas designed with deep courts and blind streets only partially cutting up the blocks, if each such court and street has a path leading from it across the block, most of its disadvantages will disappear, though it will still be less easily policed or protected in case of fire than regular blocks.

While variations to the ordinary block and lot system which do not easily conform to rule have hitherto seldom been laid out, the increased attractiveness attending their use in a reasonable number of instances demands that the opportunity be not closed by rigid standards. As they are apt to be integral parts of the group designs for the actual houses, their layout cannot be determined until the building program is adopted. Where interesting variations are not anticipated, the minimum standard of blocks, 180 to 200 ft. by 600 to 800 ft., with lots 40 to 44 ft. wide, is more apt than any other to be adapted to the future needs of a neighborhood.

THE NEW MUNICIPAL STANDARD

VERY illuminating is the story of two Ohio cities told by the State Department of Health. These cities are Wellsville and Ironton, with the unenviable distinction of having as many cases of typhoid fever in five months as two score of larger cities of the state had in the same period. Speaking exactly, these cities had 51 cases, while 80 remaining cities had 180 cases during the same period. Reduced to averages, while Ironton and Wellsville had an average of 25 cases each in five months, other cities had an average of three each. Ironton is now taking steps to remedy its defective water supply and citizens of Wellsville are waking up to past dereliction. Consumption of untreated Ohio river water is not consistent with municipal health. When both cities have completed their works they will soon lose the sorry reputation which they have gained in this vital health respect. Looking at the matter in its broader phases there is an interesting field for study opened here. Let comparisons be made among remaining cities of the state. The success of local municipal government may be told with greater accuracy in death and morbidity statistics than in any other form. If the state makes these comparisons, local communities may wince under the sting of the lashing that comes to them. But there should be no complaint in the revelations: rather obligation for demonstration of the manner in which the unfavorable showing can be converted into a favorable one.—Cincinnati Enquirer.

The Town Planning Conference for Southwesern Ontario will be held at the Royal Connaught Hotel, Hamilton, Thursday, November 27th. and Friday, November 28th. This change in time was necessary due to the Victory Loan.

THE UTILIZATION OF SEWAGE SLUDGE

(Continued from page 422)

by mechanical action alone was not a success, and of all the various proportions of humus and ripe sludge mixtures made with the view of encouraging separation, the best result was obtained where the smallest quantity of the former was mixed with the largest proportion of the latter. This is understandable when one remembers that the "humus" contains 5% to 6% of nitrogen and the oxidized sewage effluent conveying it has in its composition a sufficient quantity of nitrates to arrest putrefactive tendencies. How long this humus emulsion will remain a jelly it is difficult to say, but there are samples on the works which still retain that jelly-like character after exposure to the atmosphere for six years.

The third is not the least important function of this lagoon. Water rises to the surface when fermentation is exhausted and frequently when it is quiescent, when it may be decanted direct to the filter-bed. When one remembers that by reducing a 90% to an 80% sludge, one gets rid of one-half its water-content, the importance of decanting as much liquid as possible is evident. It has also been proved that additional advantage is gained by providing deep lagoons, thus supporting A. J. Martin's theory that the deeper the tank, the denser the sludge obtained; at the same time the benefits in this respect must be measured by the degree of emulsification obtaining.

Drying Beds

The rotted sludge or residuum of the fermentation process is pumped direct to the drying-beds which are in the immediate vicinity. They consist of plots of engine ashes 150 ft. square and have a total area of 54 acres. All the plots are under-drained with 4-in. agricultural tile-pipes in herring-bone fashion (see Fig. 4) toward a main leader which conveys the drainage to a well, whence it is pumped with water decanted from the lagoons to a percolation filter made for the purpose.

Each drying-bed is formed by earthen banks about 2 ft. high. The area is provided with a system of permanent 2-ft. gauge tramways—laid to suit loco haulage, both steam and electric battery locos (see Fig. 7)—and provided with conveniently placed turnouts and crossings to allow temporary rails to be laid through the beds for the collection of dried sludge.

The time required for drying varies with the weather, but in dry weather it quickly cracks and admits air. Fig. 5 shows the appearance of the sludge three days, and Fig. 6 thirteen days, after it has been deposited. When it has become sufficiently dry to be lifted in lumps (see Fig. 8) it should be conveyed to the tip, as it is troublesome to the workmen when it gets into the dry-as-dust state; indeed, eye protectors have had to be provided in such cases. The embankments which are being formed of the dry sludge are about 15 ft. in height. When the lumps are tipped over the embankments, the drying is completed, and the estimations for calorific value dried at 212°F. give an average of 4,500 B.T.U., or something similar to the calorific value of ordinary house and shop refuse as burnt on a destructor.

Process Complete in Itself

It should be clearly understood that this process of sludge treatment is put forward as a complete process in itself, just as the Imhoff tank process was put forward by the German engineer, but without in this case any suggestion that the effluent from the sedimentation tank could be discharged into a stream. It effectually converts an exceedingly offensive colloidal mass of sewage into a dry substance, which might be kept in one's office for years without giving off more odor than would garden soil in similar circumstances. This conversion is accomplished without nuisance at any stage, and judging by pre-war costs the expense is similar to that incurred by London and Manchester. In a report which the author submitted to the Drainage Board in June, 1914, comparative costs were given as follows:—

	Pence per ton.
London	5.6
Birmingham	5.7
Manchester	6.9

The figures for cost given by the Royal Commission on Sewage Disposal are as follows:—

	Pence per ton (90% water).
Sea disposal	4.1 to 6.9
Trenching in soil	4.0 to 7.0
Pressing (for large towns)	7.7 to 12.6
Pressing and burning	18.0

Comparing sludge digestion at Birmingham with these figures, and assuming a wet sludge containing 90% water, it is approximately 5 pence per ton.

Cost figures are bound to vary, and in comparing sludge costs care should be taken to see that the percentage of water in the sludges coincides. Another statement showed the cost to be 6.3 pence per ton of sludge (86.6% water) made up as follows:—

Statement of Cost

1. Cost of tankage, digestion and pumping to drying beds:—

	£	s.	d.
Wages	1,622	10	0
Coal	710	5	0
Stores, etc.	90	9	0
Repairs, etc.	22	10	0
Water charges	75	5	0
	£2,520	19	0

The volume of sludge dealt with was 260,000 cu. yds. Approximate cost per cu. yd. of wet sludge, 2.25 pence.

2. Cost of drying sludge, lifting and carrying to tip:—

28,816 cu. yd. of dry sludge	£990 17 7
Cost of cu. yd. of dry sludge	8.3 pence
Cost of cu. yd. of wet sludge	2.5 pence

By adding (1) and (2), wet sludge 86.6% water = 4.7 pence per cu. yd., or 6.3 pence per ton.

That the scheme as illustrated at Birmingham is as perfect as it might be made, the writer does not claim. It has been an experiment, and has been extended from time to time always as an experiment. The great tanks and lagoons, with a total capacity of 28,000,000 gals., have been built in a temporary manner out of revenue as necessity has arisen, and the design or lay-out—apart from the biological side—if design it may be called, is obviously an improvization to meet current requirements and to obtain knowledge, rather than a consistent ideal based on some well-tested prototype. Indeed our calculations were so far out of truth originally that at one time we hoped that by an intensive fermentation at Saltley, the 20 brick-built tanks, which have a capacity of only 7,000,000 gals., would suffice for treatment of all the sludge arriving there.

Success Depends Upon Nitrogen

The adoption of the scheme which has been described was due to the impossibility of septicizing sewage and sludge together without nuisance. It has accomplished what it essayed to do, thanks chiefly to the consistent work of our chemist and superintendent of works, but its final success is dependent upon the profitable utilization of the nitrogen, which up till now has been lost sight of in the predominating desire to get rid of sludge with a minimum of nuisance.

With the object of recovering from the dry sludge nitrogen and other products of distillation, a boat-load of it has been sent to the Saltley Gas Works each week for some time. Absolutely trustworthy results will not be available until more producers are installed there, but the gas works engineer, Mr. Chaney, says that he is willing to give 3s. 6d. per ton for it delivered in boat at the Saltley Gas Works.

The fact that they are possessed of a plant capable of treating sludge for a moderate sum does not satisfy the Drainage Board that they have done all that they might to

utilize the nitrogen and grease found in it to the best advantage. Some boards might say that they have done all that is required of them by controlling effectually an enormous potential nuisance, such as is represented by arresting from 300,000 to 400,000 tons of sludge and converting it into a non-smelling dry substance (which under no circumstances can be reconverted into malodorous sludge) without establishing a huge municipal trading concern for the recovery of waste products, but the Drainage Board realize the possibility of doing more than they have done, and further that it is their duty to do more if that is possible, and with that in view they entered into a contract with the Anglo-Continental Fertilizers Syndicate, Ltd., just before the war began, by which that company agreed to treat about one-fifth of the Birmingham slude with the view of recovering from it both fats and fertilizers, but chiefly fertilizers. The outbreak of war upset the project for the time being, the Treasury absolutely forbidding the expenditure of money on work of this kind, with the immediate result of encouraging the gas works experiments, which have turned out as well, and now that the war is over the company's plans are to be put into the hands of builders whose initial work is essential before the company can begin to fulfil their agreement.

Fertilizer Company's Scheme

The scheme put forward by the company is one which the author hopes to deal with in a subsequent communication, but briefly it is as follows: The sludge is warmed to a temperature of about 90°F., when a small amount of yeast (from 0.5% to 1%) is added, and the mixture allowed to remain in suitable tanks for a period of 24 hours, provision being made to keep the mixture at the optimum temperature of 90°F. As the result certain important changes take place in the character of the sludge, the particles coagulating into a compact mass which separates from the water and rises to the surface, being buoyed up by the gases evolved from the ferment. The water is run off through perforated pipes, which, whilst allowing the liquid to pass, holds back the thick sludge, and enables the separation of the water from the sludge to be effected easily and quickly, and with a minimum of labor.

Some changes other than physical are brought about by the process, and the colloids are affected to some extent, with the result that the sludge is improved for subsequent treatment.

Fermentation reduces the sludge from, say 90% water content—which is the average of ordinary sludges—to 80%, equal to the reduction of one-half the water content, thus reducing the cost of treatment. The operation being a static one the cost of working is small.

The heat used for warming the sludge is obtained from the drying process, and may be either furnace gases, or hot air and vapor from the dryers, which would be otherwise wasted.

Product Reduced to Powder

The further treatment of the sludge depends to some extent on local conditions. Moisture may be got rid of by treatment in dryers heated by means of hot air, by direct heat, or in steam-jacketed drying-pans. It can also be reduced to about 50% by an intermediate process of pressing in ordinary sludge presses, and the cake, after being broken into small pieces, finally dried to a moisture content of from 10% to 15%.

The product is reduced to a fine powder for easy application to the land; it is then in a suitable condition for further treatment if grease is present in sufficient quantity to justify its recovery.

This process is too complicated to be disposed of in a few sentences, and the writer proposes to give a detailed account of it when the works are erected and in full operation.

In the end of 1918 a committee appointed by the Institution of Municipal and County Engineers impressed upon the government the need for investigating the whole question of recovering from sewage sludge products which are worth salving. One of the government departments (the National Salvage Council) had already made preliminary inquiries at the Bradford and Huddersfield sewage works, which convinced them that grease was being recovered profitably at both of those works, and the reply of that department was both prompt and sympathetic; later, the Board of Agriculture and the Local Government Board took cognizance of the institution's demands, and in consequence a committee was formed consisting of one representative of each of the following—viz., the Local Government Board, the Board of Agriculture, the National Salvage Council, the Institution of Municipal and County Engineers, and two experts on the salvage of grease from sewage sludge—the one an engineer and the other a chemist.

This committee, formed under the ægis of the government, has just issued their report, from which the writer makes the following extracts, with the cognizance and approval of the Assistant Director of the National Salvage Council, who acted as chairman of the committee:—

"We recommend that inquiry should be instituted in other towns* as to the grease content of local sludges, as we are of opinion that where a sludge after acidification contains 15% of grease calculated on a perfect dry basis, it is profitable to recover the grease, provided the selling price is not less than £15 per ton and 100 tons of wet sludge are available for treatment daily. In these figures no note is taken of the value of the dried degreased sludge; but this is saleable, and provided the nitrogen content is 2% or more, has a market value of 10s. to 30s. per ton.

"We are satisfied that there is a shortage of organic fertilizers in the country, and that it is likely to continue.

Nitrogen Lost by Delay

"It may be taken that the amount of wet sludge produced annually in England and Wales is roughly about 250 tons per thousand of the population drained. Assuming the population drained to treatment works to be 24,000,000, the average quantity of wet sludge produced annually is about 6,000,000 tons, equal to 600,000 tons dry matter (based on 90% moisture in wet sludge), of which quantity we estimate from the data before us that not more than 12½% is utilized for fertilizing purposes.

"We are of opinion that although the sludge, as at present disposed of by local authorities after air-drying or pressing, does not contain sufficient nitrogen to enable it to compete with artificial fertilizers in manurial value, there is sufficient nitrogen in the fresh sludge, as it is removed from the tanks, to give it a definite fertilizing value. We are further of opinion that considerable quantities of nitrogen are lost by delay in disposal, in some instances as much as 50% or more of the original quantity in the sludge, and that the nitrogen so lost is the most valuable from the point of view of the possible fertilizing value of sewage sludge.

"We consider that before any attempt is made to impress upon local authorities the advisability of utilizing sewage sludge as a fertilizer, efforts should be made to increase the manurial value of sludge by some method of treatment designed to fix more of the original nitrogen in the sludge. If this could be done, it would probably add a value of 10s. per ton for each additional per cent. of nitrogen retained in the sludge for use as a fertilizer. In this connection it has to be borne in mind that at the present time many local authorities are not only unable to sell the sludge, but in some instances are called upon to pay for its removal from the works even after it has been pressed into cake.

Activated Sludge More Valuable

"We recommend that controlled experiments be carried out on a suitable scale at selected disposal works in order to ascertain the best method of dealing with sludge so as to retain as much as possible of the original nitrogen and produce a fertilizer or fertilizer base.

"We have not specifically inquired into the results to be obtained from sewage treated by the activated process, but as a result of visits made by the committee to the Manchester

*Reference had been made to towns engaged in the woolen industries.

and Sheffield Sewage Disposal Works, where the activation by aëration and activation by agitation processes respectively are under investigation, it would appear that the residual sludge from such processes contains a higher percentage of nitrogen, and consequently as a fertilizer would be of greater value than sludge produced in the ordinary way. Experiments have been commenced to ascertain its fertilizing value, but further investigation is necessary to find out the best method of dewatering and drying.

"We are strongly of opinion that the time has arrived when a government committee should be appointed to follow the recent developments in the treatment of sewage and the recovery and utilization of by-products, with a view to collecting information for the guidance of local authorities and for the benefit of agriculturists."

This document from which the writer has taken extracts shows that the committee were under no illusion about the difficulties which must be overcome if substantial progress is to be made. Underlying the report there is a conviction that it is a matter of great importance that both fertilizers and fat should be recovered, that manure for which arable and pasture lands are yearning should not be thrown away. There is no suggestion that local authorities should spend a shilling to recover elevenpence, but it is implied that some local authorities have unwittingly allowed valuable substances to go to waste by failing to erect suitable plant for their recovery.

The need for creating this attitude of mind has been reinforced by the war. It has been proved that the efficient cultivation of the soil, which is impossible without manure, is quite as essential for the Defence of the Realm as the building of ships, and so, too, it may prove that the conservation of nitrogenous matter which now goes to waste is a national necessity.

COST OF CONSTRUCTING SEWERS AND WATER MAINS IN MONTREAL SOUTH, QUE.

DURING 1918, about 22,230 ft. of 6-in., 8-in. and 10-in. water main, and 25,300 ft. of 24-in., 12-in. and 9-in. sewer were constructed for the town of Montreal South, Que. The work was done by contract, and the following figures are the actual cost to the contractor. The contractor, by the way, made no profit.

The sewer work covered the construction of mains in 17 streets. The material in which the trenching was done consisted of hard pan at the surface, a layer of shale, a bed of trap rock 3 to 5 ft. thick at 5 to 8 ft. from the surface, and shale below the trap rock. The rock excavation was paid for at the rate of $4 per cubic yard over the other material. The rates of pay for labor were as follows:—

	Per hour, cents.
Common labor	35
Pipe layers	37½
Drillers	40
Blacksmith	40
Foreman	45
Single horse and driver	40
Double team	70

The units costs on four jobs were as follows:—

Materials:—	Job No. 1. 24-in. sewer, per lin. ft. of sewer.	Job. No. 2. 12-in. sewer, per lin. ft. of sewer.	Job No. 3. 12-in. sewer, per lin. ft. of sewer.	Job No. 4. 9-in. sewer, per lin. ft. of sewer.
Pipe	$1.800	$0.590*	$0.580*	$0.370*
Cement and oakum for joints	.160	.052	.052	.040
Manholes†	.270	.290	.246	.218
Coal and oil	.015	.012	.012	.009
Total material	$2.245	$0.944	$0.890	$0.627
Labor:—				
Cartage	$0.065	$0.050	$0.050	$0.027
Excavation and pipe laying	1.755	1.940	1.850	1.590
Rock extra	1.947	2.082	1.265	1.006
Back filling	.717	.624	.605	.515
Total labor	$4.484	$4.696	$3.770	$3.138
Grand total, material and labor	$6.729	$5.640	$4.660	$3.765

*Pipe and branches. †Brick with concrete bottom and cast-iron cover, cost $70 each.

Job No. 1 consisted of 1,780 ft. of 24-in. vitrified pipe sanitary sewer with 7 manholes. The average cut was 9½ ft. in hard pan, shale and trap rock. The total excavation was 2,350 cu. yds. with 867 cu. yds. of rock extra.

Job No. 2 consisted of 2,970 ft. of sanitary sewer, 107 6-in. branches, and 12 manholes. The average depth was 10 ft. in hard pan, shale and trap rock, with the latter close to the surface in places and varying 3 to 5 ft. in thickness between shoals. The total excavation was 3,260 cu. yds. with 1,550 cu. yds. of rock extra.

Job No. 3 consisted of 11,650 ft. of 12-in. sanitary sewer laid in five streets, 296 6-in. branches, and 41 manholes. The average cut was 8½ ft. in hard pan, shale and trap rock.

Job No. 4 covers 8 to 10 ft. of 9-in. sanitary sewer on nine streets with 284 6-in. Y-branches, and 27 manholes. The average cut was 8 ft. in hard pan, shale and rock.

Owing to the direction of veins in the rock, practically the whole of the work was done by hand, except the heavy fill on backfilling, which was done by steam tractor shovel.

The water main construction involved the laying of 3,560 ft. 10-in., 7,070 ft. of 8-in., and 11,600 ft. of 6-in. Class C cast-iron pipe. All the materials except the valves were imported from the United States. Cast-iron pipe and fittings cost $46.00 per ton (2,000 lb.) on car Philadelphia. Freight and duty brought the cost to $77.00 per ton on car 2 miles from line of work. The rates of pay were as follows:—

	Per hour, cents.
Common labor	30
Pipe layers	35
Foreman	40
Single horse and driver	40
Double team	70

The following figures represent materials and laying pipe and not excavation, as the work was done under separate contract during the laying of sewers. The sewer contract providing for the backfilling over the sewer pipe to the depth of 1 ft. to allow the water main to be laid, the sewer contractor completing the backfilling.

Materials:—	10-in. main, per lin. ft. of main.	8-in. main, per lin. ft. of main.	6-in. main, per lin. ft. of main.
Pipe	$2.747	$2.040	$1.387
Gate valves and boxes[1]	.109	.111	.060
Hydrants[1]	.109	.119	.128
Leadite[2] and coal oil for heater	.080	.067	.051
Total materials	$3.045	$2.337	$1.626
Labor:—			
Cartage from cars to line of work[3]	$0.035	$0.025	$0.017
Grading trench, pipe laying, packing pipe in trench, testing	.437	.378	.279
Total labor	$0.472	$0.403	$0.296
Grand total labor and material	$3.517	$2.740	$1.922

[1]6 10-in. double gate valves and boxes at $65 each, and 6 6-in. balance valve hydrants (6 ft. fill) at $65 each, with 10-in. main; 19 8-in. double gate valves and boxes at $41.50 each, and 13 6-in. balance valve hydrants at $65, with 8-in. main; 22 6-in. double gate valves and boxes at $31.50 each, and 22 6-in. balance valve hydrants at $65, with 6-in. mains.
[2]Leadite at 20 cents per lb.
[3]Cartage at $1 per ton.

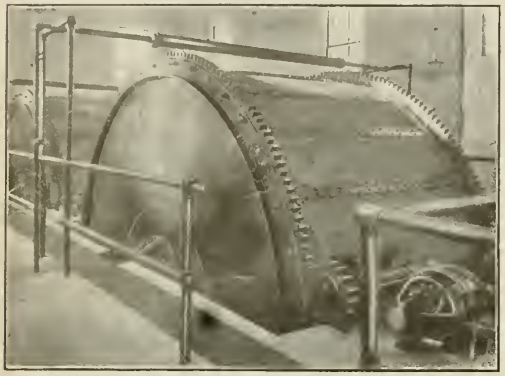
The above information was written by Ernest Drinkwater, consulting engineer, Montreal, for "Engineering and Contracting," Chicago, to whom *The Canadian Engineer* is indebted for same.

ROTARY WATER SCREENS

By L. N. Thompson
Department Engineer, St. Paul, Minn.

MOTOR-driven rotary screens are now being used very successfully by the city water department, St. Paul, Minn., for removing vegetation and solid particles from the drinking water. Prior to November, 1917, when the present system was put into operation, stationary screens were used which were cleaned with difficulty and required constant care, and were not very satisfactory. The rotary screens require practically no attention and have operated continuously since their installation.

The screens, as will be seen by the accompanying illustration, are cylindrical in shape, approximately 7 ft. long



Rotary Water Screens at St. Paul

and 14 ft. in diameter, with framework of structural steel, and have the appearance of large drums. One end is sealed tight by steel plates, the other end being left open for the entrance of water into the drum. The sides of the drum are covered with 24 sections 80-mesh Monel metal screens, which are also reinforced by ¾-in. mesh No. 8 copper wire.

The entire drum rotates about a hollow cast-iron shaft, or axle, 8 ins. inside diameter. By using two sets of roller bearings, very little power is required to operate them. A concrete wall, which is built at the open end of the drum, with an opening approximately the same radius as the drum, prevents the escape of water around the screens. Rubber belting is used between the concrete and metal frame to seal the joint.

Operation of the Screens

The unscreened water enters the open end of the drum and passes through the screens, leaving the dirt on the inside face. On the inside of the drum, near the top, extending the entire width, is a 4 by 6 ft. iron wash-water trough. Directly above the trough, on the outside of the screen, is a 4-in. pipe, the under side of which has a row of small holes, from which high-pressure streams wash through the screens and into the wash-water trough below. As the screens revolve past the trough, they are thus continually cleaned. The wash water is carried away through the hollow shaft, a very small amount of water being required to clean the screen thoroughly each revolution.

Drums Driven Independently

Either drum is driven independently of the other by a 7½-h.p. electric motor. A driving gear is connected at either end of the drum and any tortion is taken up by a differential. A speed regulator and two changes of speed in the gears give any desired rate of revolution and cleaning.

Two screens have been installed and provision made for a third. During the past year approximately 17,000,000 gallons passed the screens daily, which is far from their maximum capacity.

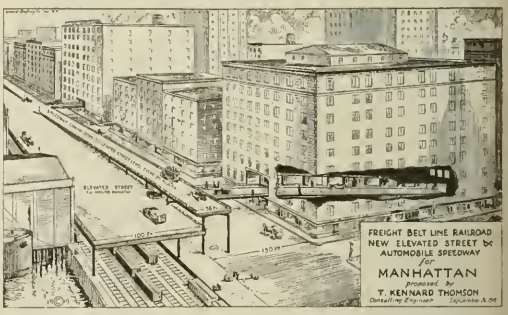
The screen chamber was built so that either or both screens can be shut off from service, and water passed around them without being screened. The screens were built by the St. Paul Foundry Co., and were designed under the direction of G. O. House, general superintendent, and W. N. Jones, engineer. The screen chamber was designed and constructed by J. W. Kelsey and L. N. Thompson, department engineers. All work was done by force account.—From "Fire and Water Engineering."

CANADIAN ENGINEER PROPOSES BIG RAILWAY SCHEME FOR NEW YORK CITY

DR. T. KENNARD THOMSON, a well-known engineering graduate of the University of Toronto, who has been in private engineering practice in New York City for many years, has designed a proposed belt line railroad to encircle Manhattan Island. The railroad is intended for freight service only. Above it, as shown in the accompanying sketch, is to be an elevated street 100 ft. wide, with a separate speedway 36 ft. wide. The speedway comes down to the level of the elevated street at every 20 blocks. Spaced only a few blocks apart, there are to be a number of inclined concourses from the elevated street to the old or lower street level. The elevated street and speedway, like the railroad, are to encircle the entire island.

Dr. Thomson declares that capitalists who are associated with him in the scheme are willing to build the railroad, streets and concourses entirely at their own expense, and donate the streets and concourses to the city without remuneration, provided that they are given a free franchise for the railroad.

The estimated cost of the whole scheme is about two hundred million dollars, but Dr. Thomson states that there are two hundred business men in New York who will finance it if the franchise is granted. When the scheme was sub-



Proposed Railway and Elevated Street, New York

mitted last month to the city's Board of Estimate and Apportionment, it was referred to the Committee on Franchises. Whether the franchise will be granted or not is a matter of considerable doubt; nevertheless the many Canadian engineers who know Dr. Thomson will, no doubt, be much interested in his ingenious scheme.

The American Association of Engineers received 902 applications for membership between October 1st and October 23rd, and the qualifications committee approved the admission of about 700 members.

The annual meeting of the American Road Builders' Association will be held November 7th at the Automobile Club of America, New York City. There will be two sessions for the purpose of receiving seven committee reports and annual reports of officers, electing new officers, etc.

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CHICAGO DRAINAGE CANAL DIVERSION

AGAIN comes the plea, often repeated, for permission to increase the diversion of water for the Chicago Drainage Canal. This time Francis C. Shenehon, Dean of the College of Engineering, University of Minnesota, who was at one time District Engineer of the U.S. Great Lakes Survey, is its special advocate. He proposes that the effects of the diversion be compensated for by remedial works on the Great Lakes, these works to be financed by the Chicago Drainage Canal Commission.

The history of the canal is too well known to warrant repetition. It suffices to say that to-day the commissioners in charge of the drainage district, in defiance of all governmental authority, are diverting approximately 10,000 cubic feet per second, while the permit issued by the U.S. Secretary of War, in whom is vested jurisdiction over, and discretionary powers appertaining to, the navigable waters of the United States, gives them the right to divert not more than 4,167 cubic feet per second.

Canada has protested many times against this extraordinary state of affairs, but to no avail. As a matter of fact, the Canadian authorities were not even consulted when the original permit was granted. Many are the arguments against increased diversion and in favor of limiting the canal to the original permit of 4,167 cubic feet per second. Despite Canadian protests, the United States government has taken no adequate steps to enforce its orders and to prevent this wanton breach of constituted authority.

Mr. Shenehon now presents this scheme of remedial works which, if accepted, would allow the drainage commissioners to perpetuate their illegal diversion, and which would afford an easy method for the United States government to step out of its difficult position of being unable, even with the authority and prestige of its Supreme Court, to enforce its rightful prerogatives.

But this proposition is not acceptable to Canada; although remedial works on the lakes may partially compensate for the injuries to navigation, they cannot compensate for the power that will be lost to both countries as a result of the diversion. It is generally conceded by those who have been in intimate touch with the original scheme, that the development and sale of the power now obtained on the Drainage Canal under a 40-ft. head, is the great incentive to the diversion of additional water. The sale of this power is in the hands of the commissioners, and it finds a ready market in the drainage district.

This water, if carried along in its proper course through the Niagara and St. Lawrence rivers, could be used at the several points of development under a total head of fully 500 ft., which means approximately 500,000 h.p. Canada's share of this 500,000 h.p. will be permanently lost if the Chicago diversion is legalized by the acceptance of "compensation" for damages to navigation.

BRITISH OPTICAL FIRMS BUSY

ONE result of the war in England has been an enormous development of the optical manufacturing firms, states A. J. Ames, managing director of E. R. Watts & Son Canada Limited, who recently returned to this country after a four months' visit to his firm's English factory.

"As an instance of this development," says Mr. Ames, "I might mention that within a fortnight of my sailing for Canada, our London house had received orders for the following important geodetic instruments:—

"Twenty 12-in. micrometer transit theodolites reading to one second; fifteen 8-in. micrometer transit theodolites reading to two seconds; and one hundred and fifteen 6-in. micrometer transit theodolites reading to ten seconds.

"This does not take into consideration large orders for ordinary surveying and scientific instruments, nor does it reckon with the very large number of instruments connected with the various war departments in Britain, contracts for which are still being concluded.

"In pre-war time one seldom heard of an order for 12-in. micrometer theodolites for more than two at a time, and very often only one of these most important and precise instruments was ordered."

With labor conditions as they are in England, one wonders where all the business is coming from to keep the large optical firms so busy. However, everyone who has visited Great Britain since the war agrees that a wonderful change has taken place in the "old country," and that hereafter they are going to be more "up and doing" than ever. When British competition strikes its stride, Canadian and United States firms may have to hustle for their fair share of Canada's business.

NOVA SCOTIA POWER COMMISSION

UNDER the Power Commission Act passed at the last session of the Nova Scotia Legislature, a power commission for that province was recently appointed and is undertaking definite investigations with a view to an early development of certain water powers adjacent to the city of Halifax. The members of the commission are Hon. E. H. Armstrong, commissioner of Public Works and Mines (chairman), R. H. MacKay, of New Glasgow, and F. C. Whitman, of Annapolis. K. H. Smith, hydraulic engineer of the Dominion Water Power Branch, who for some time past has been in charge of hydrometric work and water power investigations in the maritime provinces and at the same time has acted as engineer to the Nova Scotia and New Brunswick authorities concerning water power matters, has been appointed chief engineer and acting secretary of the commission. It is expected that Mr. Smith will be able to continue in his present capacity with the Water Power Branch.

PERSONALS

J. C. Reilly, who was recently appointed acting general secretary of the Association of Canadian Building and Construction Industries, was born September 10th, 1881, in Toronto. He received his primary education at the Clinton St., Manning and Ryerson public schools, Toronto, and after two years in a law office and seven years with R. G. Dun & Co., he entered McGill University to study arts and theology. Mr. Reilly graduated from McGill in 1910, and became assistant at the St. James' Methodist Church, Montreal. Two years later he resigned in order to pursue further theological studies at the Harvard Divinity School, Boston. During the war he was overseas with the Y.M.C.A., returning in July this year. Mr. Reilly seems to have liked building construction as well as theology, as he was employed in various capacities by building contractors and architects during the summer vacations throughout his college courses. He was timekeeper, foreman, etc., on various large construction jobs in Montreal, including the McGill Engineering building. He has decided not to return to the ministry at present, and it is expected that his appointment as permanent secretary of the Association of Canadian Building and Construction Industries will be confirmed at the next annual conference of the association, which will be held the week of January 26th, 1920, in Ottawa.

J. A. Duchastel, city engineer of Outremont, Que., and past president of the Canadian Good Roads Association, has been nominated as one of the vice-presidents of the American Road Builders' Association.

A. W. Swan, assistant advertising manager, Canadian Ingersoll-Rand Co., Ltd., Sherbrooke, Que., has resigned in order to accept an appointment as assistant secretary of the Engineering Institute of Canada, with headquarters at Montreal.

Dr. Ernst Steiner, a member of the Swiss political and trade mission to the United States, is in Canada for the purpose of investigating our hydro-electric developments. Dr. Steiner has visited Niagara Falls twice and expects to go to Montreal and Winnipeg. He is a graduate of the polytechnic school at Zurich and is in private practice as a civil engineer. In an interview with *The Canadian Engineer*, Dr. Steiner stated that the Queenston-Chippawa development will be the greatest in the world at the time of its completion.

OBITUARY

J. E. Sirois, president of the Corporation of Quebec Land Surveyors, died recently at his home in St. Anne de la Pocatière, Que., aged 61.

The firm of C. H. & P. H. Mitchell, Toronto, has been consulted by the Nova Scotia Power Commission with a view to definite action at an early date.

Letter to the Editor

RULES FOR DRAFTING PRACTICE

Sir,—In reading the rules for drafting practice, by H. N. Savage, published in your issue of October 16th, I note that the dimensions of the drawings are somewhat similar to those originated by L. L. and P. N. Nunn for the Ontario Power Co. during the construction of the No. 2 pipe line. Each size is designated by a letter and the dimensions are multiples of letter size, as follows:—

Letter.	Out to Out.	Inside Border Line.
L	8½ by 11 ins.	8 by 10½ ins.
M	11 by 17 ins.	10¼ by 16¼ ins.
A	17 by 22 ins.	16 by 21 ins.
B	22 by 34 ins.	21 by 33 ins.
C	34 by 44 ins.	32½ by 42½ ins.
D	34 by (44+) ins.	32½ by [(44+)—¾] ins.

GERALD HAMILTON.

Niagara Falls, Ont., October 21st, 1919.

CORRECTION

In the report of the meeting held by the Toronto branch of the Engineering Institute of Canada for the adoption of a schedule of salaries, qualifications, etc., for engineers, the following paragraph appeared on page 397 of last week's issue of *The Canadian Engineer*:—

"After Mr. Clark had read the schedule in regard to railway work, Mr. Harkness inquired regarding the present rate of pay received by railway brakemen, and was informed by Mr. Clark that it amounts to between $300 and $330 per month."

Mr. Clark calls attention to the fact that the rate of pay mentioned by him is that received by railway freight conductors. Mr. Harkness had inquired regarding brakemen, but Mr. Clark's reply did not refer to brakemen's wages.

Pion & Grothe, contractors, have asked the city of Montreal to arbitrate their claims with regard to the construction of the Lasalle bridge, and have instructed F. C. Laberge to act for them. The city council recently decided to settle the claims in accordance with the Act passed by the provincial legislature.

Following is a partial list of Canadian patents recently issued through the agency of Ridout & Maybee, Toronto: Edward B. Killen, vehicle spring suspensions; Fred L. Rapson, lifting jacks and the like for use on motor, road and other vehicles; Woodington & Young, abrasive wheel; J. Stone & Co., Ltd., valves for fluid pressure systems adapted for operating bulkhead and like doors; Farm & Dairy Machinery Co., pneumatic valve actuating devices.

A public meeting of the North Atlantic Division of the National Highway Traffic Association will be held at the Automobile Club of America, 247 West 54th St., New York City, at 8 p.m., November 7th. The program includes the following: Progress report of committee on "Sign Posting for Detours and Through Routes in Municipalities," by Elmer Thompson (chairman), secretary, Automobile Club of America; "Present Status of Impact Tests on Roadway Surfaces," by A. T. Goldbeck, testing engineer, United States Bureau of Public Roads; "Motor Vehicle Traffic which Requires the Use of Cement-Concrete Foundations," by W. G. Thompson, state highway engineer of New Jersey; "Relation of the Motor Truck to the Railroad," by C. W. Reid, manager, Transportation Bureau, Federal Highway Council. Dinner will be served in the grill room of the club at 6.30 p.m. The public is invited to attend both the dinner and the meeting. Dinner reservations should be addressed to Elmer Thompson, 247 West 54th St., New York City.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand or proposed, contracts awarded, changes in staffs, etc.

BRIDGES, ROADS AND STREETS

Bedford Tp., Que.—The township council decided to carry out a programme of road improvement. Application will be made to the Provincial Road Department for $20,000 under the Good Roads Act, and the roads will be built as early as possible next year.

Golden, B.C.—Tenders are being called by the Provincial Public Works Department for the construction of a bridge over the Kicking Horse River at Golden.

Quebec, Que.—It is rumored that the provincial government will spend $10,000,000 on 650 miles of roads next year, provided that the federal subsidy of 40 per cent. of the cost of construction is forthcoming. Five trunk routes are planned: Montreal to the Laurentian Mountains, Montreal to Hull, Montreal to Sherbrooke, Levis to Rimouski, and Levis to Longueuil.

South Vancouver, B.C.—The sum of $60,000 has been spent on roads and sidewalks this year. This amount includes both work that has been done and contracts let, but not yet completed.

Toronto, Ont.—The completion of the Teraulay St extension, from College St. to St. Vincent St., will be taken up with the Board of Control by Mayor Church.

Vancouver, B.C.—The city council have received word from S. J. Crowe, M.P., that the federal Department of Public Works is prepared to expend the government grant for the repairs to Marine Drive bridge on terms previously arranged.

Victoria, B.C.—Plans for construction work on the Pacific Great Eastern Ry. include a steel cantilever bridge across the Cottonwood River.

Victoria, B.C.—The provincial Department of Public Works is arranging its programme of road improvements in the Fernie, Columbia Valley and Creston districts so that the main traversing trunk roads will be in such a state as to link conveniently with the Dominion government's Banff-Windermere highway on its completion.

Welland, Ont.—City engineer Chas. L. Coulson estimates the cost of extending Pine St. to Aqueduct St. at $2,500.

West Vancouver, B.C.—Permission has been given by the Dominion government for the appropriation of the $11,000 intended for the construction of a new bridge on Marine Drive, to be diverted to the repair of the old one.

WATER, SEWAGE AND REFUSE

Assiniboia, Man.—The municipal council will undertake the sinking of two 5-inch wells, and will supply same with the necessary pumps and platforms. Secretary-treasurer, Frank Ness, Kirkfield Park P.O., Man.

Brandon, Man.—City council is considering the installation of sewers in the eastern part of the city. City clerk, Harry Brown.

Burnaby, B.C.—A waterworks extension by-law will likely be submitted to the ratepayers in January. Clerk, Arthur G. Moore.

Grand Forks, B.C.—Work has started on the proposed irrigation system, and a complete topographical survey of the system is being made. District engineer, W. J. E. Biker, Court House, Grand Forks.

Guelph, Ont.—City council received a petition for the extension of the sewer on Lyon Ave. for a distance of 150 ft. City engineer, F. McArthur.

Hamilton, Ont.—City engineer E. R. Gray will prepare plans for the installation of a sewer on Simcoe St. West.

Hamilton, Ont.—The extension of the Burlington St. sewer, for the benefit of the Firestone Company's plant, which will be located here shortly, was discussed at a recent meeting of the works committee. City Engineer Gray estimates the cost at $34,000.

North Vancouver, B.C.—The city council have authorized the installation of a ¾-inch water service to H. Hobson's shingle mill at the foot of Bewick Ave.

Peterboro', Ont.—City engineer R. H. Parsons has been instructed by the city council to prepare plans for a sewage disposal plant to be installed in Otonabee district. Provision will be made in the plans for Imhoff tanks and a pumping station.

Peterboro', Ont.—The Board of Works has been asked by the Health Department to install a sewer to the site of the proposed Memorial School. The matter was referred to City Engineer Parsons.

Regina, Sask.—City council is considering a sewer and water extension to Block 15, C.P.R. Annex.

Toronto, Ont.—The Ontario Oakoal Co. have made an offer to the city council to take over the incinerator on Strachan Avenue, known as the cattle market site. The company propose to use the site for a plant for the manufacture of Oakoal.

Toronto, Ont.—Tenders addressed to T. L. Church (Mayor), chairman, Board of Control, City Hall, Toronto, will be received up to 12 o'clock noon on Tuesday, November 18th, 1919, for the supply and delivery of water meters. Specifications may be obtained at the Works Department, Room 12, City Hall.

Victoria, B.C.—The city council is considering extending the waterworks system to Gordon Head. City clerk, W. J Dowler.

Victoria, B.C.—City Engineer F. M. Preston is preparing a statement for Gordon Head, Saanich, showing the cost of irrigation.

Welland, Ont.—City engineer Chas L. Coulson estimates the cost of the proposed Crowland Ave. sewer at $15,650.

Winnipeg, Man.—Tenders addressed to R. D. Waugh, chairman of Commissioners, Greater Winnipeg Water District, 201 Tribune Building, will be received up to noon on Monday, November 10th, 1919, for the supply of remote electric control for two 36-inch gate valves. Specifications may be obtained at the office of the District.

Winnipeg, Man.—Tenders addressed to the chairman, Committee on Fire, Water, Light and Power, will be received at the office of C. J. Brown, city clerk, up to 3 o'clock p.m. on Monday, November 3rd, 1919, for laying the following water mains: In Jubilee Ave., from Lilac St. to Pembina Highway; in Brock St., from Academy Rd. to Lot 27, Block 9, Plan 1222, DGS. 51-2, St. Boniface. Specifications may be obtained at the office of the city engineer, 223 James Ave.

York Tp., Ont.—Deputations waited upon the township council relative to better water services on Beresford, Morningside and Watford Avenues and Durie St. Frank Barber, township engineer, 40 Jarvis St., Toronto, was instructed to make a survey and report upon same.

LIGHT, HEAT AND POWER

Galt, Ont.—The ratepayers will vote on a by-law to provide $30,000 for a central heating plant at the hospital. City clerk, Jos. McCartney.

Hampton, N.B.—The municipality will install an electric lighting system at a cost of $15,000.

Saskatoon, Sask.—Contract has been awarded for supply and erection of one 4,500 k.w. turbine and condenser for the power-house as follows: To the Canadian Westinghouse Co., Hamilton, $149,813. Rejected tenders from Dominion Bridge Co., Montreal, $159,310; Fraser and Chalmers, Montreal, $164,000. Separate tenders were also received for the turbine generator and switchgear as follows: Canadian General Electric Co., $92,609; Canadian Westinghouse Co., $114,643; Dominion Bridge Co., $126,500; Fraser and Chalmers, $132,000. Separate tenders for the condenser and equipment were as follows: Alberger Pump and Condenser Co., $24,135; Goldie and McCulloch, $29,965; C. H. Wheeler Manufacturing Co., $26,000; Canadian Westinghouse Co., $35,745; Dominion Bridge Co., $32,810; Fraser and Chalmers, $37,650.

Toronto, Ont.—A portion of the Glebe property between Harris' and Woodbine Ave. has been purchased by the Hydro-Electric Power Commission of Ontario for a power station in connection with the proposed eastern radials.

Unity, Sask.—Work will start immediately on the installation of an electric lighting system, estimated to cost $25,000. Secretary-treasurer, J. M. Jesson.

Winnipeg, Man.—Next year the city will spend $1,350,000 on its Hydro-electric system if a recommendation by the Fire and Light Committee is adopted by the city council.

Winnipeg, Man.—Tenders addressed to the chairman, Committee on Fire, Water, Light and Power, will be received at the office of C. J. Brown, city clerk, up to 3 o'clock p.m. on Monday, November 3rd, 1919, for the manufacture and delivery of steel towers required for a duplicate high-tension electric power transmission line between Point du Bois and Winnipeg. Plans and specifications may be obtained at the office of the City Light and Power Department, 54 King St.

York Tp., Ont.—The township council instructed their solicitor to prepare the necessary by-law to issue $2,000 worth of debentures for a hot water heating system in the school in Section No. 31.

RAILWAYS

Alvin, B.C.—Small and Bucklin, New Westminster, propose to construct a logging railway in Pitt Valley, near here.

Bancroft, Ont.—It is reported that the C.N.R. authorities have in mind the construction of a line from Bancroft and Combermere to connect with the C.N.R. line at Alice township, a distance of about 40 miles.

Edmonton, Alta.—The Dominion government has decided not to purchase the Edmonton, Dunvegan and British Columbia Ry., as was proposed. The C.P.R. has been looking over the line and may purchase it.

Quebec, Que.—A provincial charter has been granted to the Quebec and Chibogamau Ry. The company intends to build a line from Quebec City as far north as Lake Chibogamau. Joseph Cote, agent, of this city, is among the incorporators of the company.

New Westminster, B.C.—The Grand Forks–Lynch Creek branch of the Kettle Valley Railway is being reballasted and heavy rails will replace the light rails now in use. Considerable side-tracking will also be laid.

Oshawa, Ont.—On November 22nd the ratepayers will vote on the question of the construction and operation of the Toronto and Eastern Hydro radial, to operate between Bowmanville and Toronto.

Toronto, Ont.—City council endorsed the recommendation of the Board of Control to apply to the legislature for authority to issue debentures for $160,000 for the Bloor St. car line without the assent of the ratepayers.

Toronto, Ont.—City council decided to call for plans and ask Commissioner of Works R. C. Harris to advertise for tenders for the Mount Pleasant car line.

Toronto, Ont.—The construction of the Pape Ave. car line extension by July 15th next is called for by an order issued by the Ontario Railway and Municipal Board. Construction is to begin not later than April 15th.

Windsor, Ont.—Plans of the Ontario Hydro-Electric Power Commission to purchase the Sandwich, Windsor and Amherstburg Street Railway system were laid before the border municipalities on October 25th, by Sir Adam Beck, who has notified Mayor Winter that an order-in-council, giving power to the commission to take a vote of the people on the project, has been authorized by the Ontario government.

FACTORIES AND LARGE BUILDINGS

Alberni, B.C.—Parfitt Brothers, Victoria, have secured the contract for the erection of a new Indian school. Estimated cost of building, $70,000.

Brandon, Man.—A by-law will be submitted to the ratepayers at the next municipal elections to authorize the borrowing of $150,000 for erecting and furnishing new school buildings.

Bridgeburg, Ont.—An addition is being built to the Pratt and Lambert factory here which will practically double its capacity.

Burnaby, B.C.—The School Board is considering the erection of a school building north of Burnaby Lake.

Calgary, Alta.—The city council has been asked to provide a further sum of $102,140 for permanent improvements at the fair grounds, including a $45,000 addition to the cattle sheds.

Calgary, Alta.—Contract has been let to J. G. Edwards for the erection of a $30,000 garage at the corner of Second St. East and Ninth Ave. for Lougheed and Taylor. Work will be commenced shortly on this building, which will measure 120 ft. by 175 ft.

Chatham, Ont.—The Wilson Co., an American packing company, have purchased the Chatham Abattoir, and plan an extension to the building.

Edmonton, Alta. — A station costing approximately $1,000,000 and a big programme of expansion will be undertaken by the Canadian National Railways here. The station will likely be five stories high. It is also reported that the company will build shops in Edmonton similar to the Ogden shops at Calgary. The programme has been approved and only requires sanction of the Railway Board. It is expected work will start in the spring.

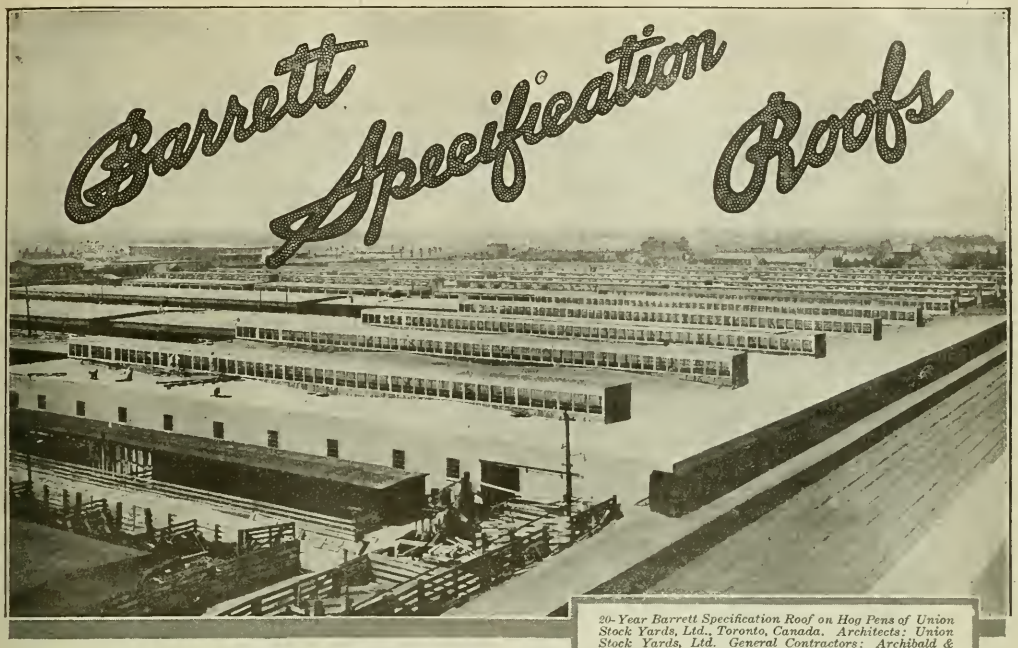
Edmonton, Alta.—It is probable that a new immigration hall, costing about $40,000, will be built here by the Dominion government next spring.

Edmonton, Alta.—A new building will be erected next year on 101st St. by the Edmonton "Journal." The new structure will have floor accommodation of 22,500 sq. ft.

Edmonton, Alta.—Contract awarded to Carter-Halls-Aldinger, of Winnipeg, for the erection of an eight-story warehouse in this city to cost approximately $150,000.

Edmonton, Alta.—Estimates on the cost of an eight-roomed addition to Norwood School, and also a new school on Spruce Ave., are being called for by the Public School Building Committee. Further information from Building Commissioner Story.

Edmonton, Alta.—The Public School Board decided to erect a model school in Garneau to serve as a temporary building until plans have been completed with the university authorities and the government for a permanent building on the university grounds. Tenders will be called for at once.



20-Year Barrett Specification Roof on Hog Pens of Union Stock Yards, Ltd., Toronto, Canada. Architects: Union Stock Yards, Ltd. General Contractors: Archibald & Holmes, Toronto, Can. Roofers: The Maitland Roofing & Supply Co., McDermid Bros. Successors, Toronto, Can.

100,000 Square Feet of Barrett Specification Roofs

The above photograph shows the mammoth new Hog Pens of the Union Stock Yards, Ltd., Toronto, in process of construction.

This is a roofing job of more than one hundred thousand square feet, covering one continuous building, extending back beyond the sixth monitor in the picture.

Naturally, in deciding what type of roof to adopt for this enormous plant, the question of cost had to be given careful consideration.

It is significant, therefore, that a Barrett Specification Roof should have been decided on.

It means that the Union Stock Yards architects fully realize what so many architects and builders have come to appreciate—that it *pays* to buy the *best* roof because, while the original cost may be a little higher, *the cost per year of service is lower than for any other type.*

This plant has a roof that will stand up year after year under the rigorous Canadian climate; one that takes the base rate of insurance and that is guaranteed for 20 years.

Guaranteed for 20 Years

So sure are we of the service Barrett Specification Roofs will give *under the most severe conditions* that we are prepared to *guarantee them for 20 years*, in all towns of 25,000 or over, and in smaller places where our Inspection Service is available, provided they are 50 squares or more in area. The guaranty costs you nothing. We merely require that our Specification dated May 1, 1916, shall be strictly followed and that the roofing contractor be approved by us. The guaranty is a Surety Bond issued by a well-known fidelity and guaranty company.

A copy of The Barrett 20-Year Specification, with roofing diagrams, sent free on request

The Barrett Company LIMITED

MONTREAL TORONTO WINNIPEG VANCOUVER
ST JOHN, N.B. HALIFAX, N.S. SYDNEY, N.S.

Hamilton, Ont.—The British-American Oil Co., Toronto, has decided to erect a $100,000 plant in this city. A permit for the erection of the building has been issued. President, C. S. Shorman.

Hamilton, Ont.—Tenders addressed to McPhie and Kelly, architects, Bank of Hamilton Building, will be received up to noon, October 31, 1919, for the erection of a Sunday school building on Summit Ave., Mountain. Plans and specifications may be seen at the offices of the architects.

Hamilton, Ont.—Bird and Son have secured a permit for the erection of an office building on Beach Rd., at a cost of $10,000.

Kitchener, Ont.—The Kitchener-Waterloo Collegiate Board decided to give competing architects until December 1st to submit plans for the proposed new Collegiate Institute building.

Kitchener, Ont.—The Industrial Committee of the Board of Trade has before it at present proposals from a United States spinning company about to locate a mill in Canada, and from another United States manufacturer of auto jacks and hardware specialties who will shortly establish a plant in Ontario.

Kitchener, Ont.—It has been announced here that certain local business concerns have invited W. N. McEachren, Son and Co., at present engaged in housing enterprises in other Ontario cities, to come to Kitchener to lead in the formation of a company, to be known as the Ontario Housing Co., with a view to solving the present housing stress in this city. It is understood that between 200 and 300 of the leading men of the city will make up the new company, and that between 15 and 25 houses will be erected immediately, and that this number will be augmented to between 200 and 300 houses in the spring.

Montreal, Que.—The Raymond Concrete Pile Co., Ltd., New Birks Building, Montreal, have been awarded the contract for the piling for the additions to the Holt, Renfrew and Co., Ltd., factory, McGill College Ave., Montreal, by H. C. Johnston Co., general contractors.

Montreal, Que.—The city council at their next meeting will be asked by the Administrative Commission to approve of the new by-law making it compulsory that all public buildings, schools, hospitals, hotels, large apartment houses and all buildings over sixty feet in height or more than three stories in height be built of fireproof material.

Montreal, Que.—Tenders addressed to the Catholic School Commissioners of Montreal will be accepted up to November 4th, inclusive, for the construction of the St. Thomas Aquinas School, Convent St., St. Henry. The said School Commissioners request the following: 1. Tenders for the general contract of said school. 2. Tenders for separate contracts on the following items: (a) Digging, excavations, masonry and concrete works, carpenters' work, plastering. (b) Electricity. (c) Roofing, tinning and ventilation. (d) Plumbing, heating. (e) Painting and glasswork. The plans and specifications may be examined at the office of Amos and David, architects, 76 Crescent St., Montreal.

New Toronto, Ont.—The Canadian Photo-Play Productions, Ltd., has purchased a site here for the erection of a studio to cost approximately $150,000. Steel, concrete, stone and brick construction. Excavation work has already been commenced.

New Westminster, B.C.—A new utility building being constructed by the Swift-Canadian Packing Co. at Sapperton is nearing completion. This work is costing between $6,000 and $7,000. A new cooler building has been completed and is now in operation, while an additional power plant is to be added.

Niagara Falls, Ont.—The Shredded Wheat Co., with plants on both the Canadian and American sides at Niagara Falls, will spend about $750,000 for plant enlargement.

Point Grey, B.C.—A permit has been issued for repairs to Shaughnessy Military Hospital to cost $20,000.

Port Coquitlam, B.C.—The Gregory Tire and Rubber Co. will erect a factory here.

Prince Albert, Sask.—The Prince Albert Hotel, which was partially destroyed by fire recently, will likely be rebuilt.

Prince Rupert, B.C.—Negotiations are under way between the city, the Grand Trunk Pacific and the American Canning Co. to build a plant here.

Province of New Brunswick.—Plans are ready for a new mill for the Nashwaak Pulp and Paper Co. in this province.

Quebec, Que.—Building permits have been issued to the Champlain Brewery Co. for the erection of a new structure at the corner of Church and Prince Edward Sts. at an approximate cost of $100,000, and to the Paquet Co. for the erection of a building at an estimated cost of $110,000.

Peterboro', Ont.—The Canadian Woollens, Ltd., have taken out three permits, aggregating $85,000, including a $40,000 factory building, a $10,000 office building and a $35,000 factory building at their Auburn plant. Architects, W. Blackwell and Son.

Port Colborne, Ont.—Tenders addressed to C. D. Howe and Co., superintending engineers, Port Colborne, Ont., will be received until noon of November 1st, 1919, for manufacture and erection of spouting and sheet metal work in connection with the reconstruction of the government elevator here.

Redcliff, Alta.—The Dominion Glass Co. is building a $100,000 addition to their plant here.

Regina, Sask.—Hancock, Sons and Co. propose to erect a monumental workshop and showroom.

Regina, Sask.—Excavation work has started for a $100,000 addition to the store of Seller and Sons.

Regina, Sask.—It is expected that $100,000 may be spent next year to extend the Fort Qu'Appelle Sanatorium.

Regina, Sask.—The Western Implement Co., of this city, has let contract to D. J. McKay for the erection of a warehouse on Osler St. North. Estimated cost, $15,000.

Regina, Sask.—The Saskatchewan Oakole Co., which is being incorporated here, proposes to erect a building at a cost of $35,000 or $40,000 for the manufacture of garbage into fuel briquettes.

Regina, Sask.—The American Corporation, New York City, organized by E. H. Turnbull, of London, Eng., who is associated with Gen. J. F. O'Ryan, of New York, has purchased 200 lots in this city, and plans are under way for an extensive house building scheme to be undertaken in the spring.

Renfrew, Ont.—Construction work on the Carnegie public library will be proceeded with shortly.

Renfrew, Ont.—The ratepayers passed a by-law to raise $25,000 for the erection of a new fire hall. Along with the fire hall there will be installed a central heating plant. Town clerk, J. A. Devenny.

Sandwich East, Ont.—The General Motors Corporation have purchased 600 acres here. The land, which is near the $6,000,000 plant the corporation is building on the Walker Rd., Walkerville, will be used as the site of a model town for employees. In the meantime temporary quarters will be erected by the corporation. More than $1,000,000 will be spent in building workmen's houses.

Saskatoon, Sask.—Two hundred thousand dollars is the sum stipulated in a resolution drawn up by City Commissioner C. J. Yorath, and endorsed by the G.W.V.A., asking for assistance from the government for the city in providing homes for returned soldiers.

Sherbrooke, Que.—The Canadian Connecticut Cotton Mills may erect a factory here.

Sherbrooke, Que.—The city council has selected a site for the erection of a Technical School. Mayor, Chas. D. White.

Sherbrooke, Que. — The provincial government will shortly pass an order-in-council providing for a loan of $500,000 to this city for housing problems.

BURLINGTON
STEEL CO LTD
HAMILTON
B
S
STEEL
BARS
FOR CONCRETE
REINFORCING
GTD
ROUNDS SQUARES FLATS CHANNELS ANGLES
TWISTED SQUARES SPECIAL SECTIONS
BARS BENT TO SHAPE FOR BEAMS, STIRRUPS, ETC.
PROMPT SHIPMENT

Sherbrooke, Que.—A new hospital, under the name of the "Noel Hospital," will be established here shortly if the Legislature will grant the demand of residents of this city at the next session.

Springfield, Ont.—A new school building will be erected in the near future. Clerk, J. B. Lucas.

St. Boniface, Man.—Contract awarded to the Carter-Halls-Aldinger Co., Winnipeg, for the erection of a $65,000 foundry for the Western Wheel Foundries Co., Ltd., Messier St.

St. Boniface, Man.—A permit has been granted to the Dominion Linseed Oil Co. for an additional building estimated to cost $10,000. The building will be four stories high, 45 by 48 ft., and of mill construction.

St. John, N.B.—Dr. Bridges, chairman of the School Trustees, has recommended the erection of an addition to the High School.

St. John, N.B.—Plans for the erection, early next spring, of a three-story wooden memorial hall, to be built in the rear of St. Luke's Church, have been adopted by St. Luke's Memorial Committee. Estimated cost, $10,000.

Sydney, N.S.—Capt. A. J. Morrison, treasurer of the local branch of the Navy League, has announced that a Sailors' Home will be erected here. Estimated cost, $25,000.

Toronto, Ont.—The North Riverdale Ratepayers' Association are urging the city council to erect a hospital in the Riverdale district.

Toronto, Ont.—Chas. Barker, 230 Mount Pleasant Rd., has secured a permit to build an addition to his automobile paint shop at a cost of $3,800.

Toronto, Ont.—Harry Simpson, architect, has completed plans for an additional story to the Garrett Motor Co.'s garage at 2574 Yonge St.

Toronto, Ont.—City council approved an amendment to the building by-law to permit the proposed erection of an addition to the King Edward Hotel.

Toronto, Ont.—Plans for the erection of a $250,000 Labor Temple are under serious consideration among the leaders of the movement in this city.

Toronto, Ont.—W. E. Dyer, of this city, proposes to erect a series of quadruple bungalows in the north-west section of the city, just south of St. Clair Ave.

Toronto, Ont.—In connection with the proposed public lavatory for the Danforth district, near the Bloor St. viaduct, eastern approach, the plans have been completed and work will shortly commence.

Toronto, Ont.—Frederick S. Williamson, of this city, has secured a $150,000 contract from the Toronto Housing Commission for the construction of 48 houses on Stacey St., between Coxwell and Hillingdon Avenues.

Toronto, Ont.—A site for the new public library for Earlscourt has been purchased by the Library Board on South Dufferin St., two blocks from St. Clair Ave. Chief librarian, George H. Locke. The new building will be of brick, and the cost will be around $50,000.

Toronto, Ont.—It is stated that the "mystery block," bounded by Carlton, Alexander, Yonge and Church Sts., has been purchased by the C.P.R., and that the company proposes to erect a $3,000,000 hotel and underground terminal on the site. The company has also purchased land for the construction of a 100-ft. tunnel from the hotel to their North Toronto station, a distance of a little over a mile.

Toronto, Ont.—The following building permits have been issued by the city architect's department: Eastern Theatres, Ltd., to erect theatre and lobby building on Victoria St. and lobby building at 263 Yonge St. at a cost of $268,000; Separate School Board to build two-story brick school at 52 Edgewood Ave., near Gerrard St. East, at a cost of $52,000; E. M. H. Beards, 502 Huron St., to repair fire damage to warehouse, 107 Front St. East, $7,000.

Toronto, Ont.—The Massey-Harris Co. have secured a permit to build a $1,200 addition to their No. 8 warehouse at the corner of Stafford and Wellington Streets.

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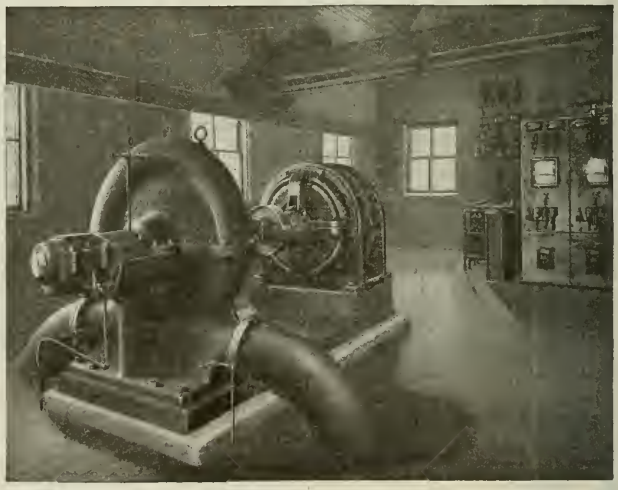

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Toronto, Ont.—The Canadian General Electric Co. have received a permit to build a new $135,000 warehouse at the corner of King and Simcoe Streets, and a further permit to bridge the private lane between the new warehouse and their present one, at an estimated cost of $2,000. A permit has also been issued to the Canadian Allis-Chalmers Co. for the erection of a pipe-galvanizing plant at the corner of King and Simcoe Streets, which will cost $35,000.

Trenton, Ont.—The Bell Telephone Co. has purchased a site on Dundas St. and proposes to erect a telephone exchange building there.

Vancouver, B.C.—The Cut-to-Fit Buildings Co., of this city, proposes to erect a factory and mill.

Vancouver, B.C.—A movement is on foot here for the erection of a curling club building. Club secretary. W. W. Moore.

Vancouver, B.C.—Messrs. Prescott, Lamb and Upton recently interviewed the Minister of Education, Victoria, regarding what assistance will be given to the locad board by the government toward the establishing of a technical school in the city.

Vancouver, B.C.—A recent fire at the British Columbia Fir and Cedar Lumber Company's mill destroyed the mill, dry kilns and more than half a million feet of lumber, together with the storage shed of the Alberta Lumber Co. The loss is estimated at $400,000.

Vancouver, B.C.—Plans are being prepared by W. D. Rochefort for the erection of a theatre at the north-west corner of Richards and Georgia Sts. The work is being pushed through by a syndicate known as the Vancouver Theatre Co., Ltd. Estimated cost, $275,000.

Vancouver, B.C.—The Methodist Mission of Canada have taken out a permit for the erection of a gymnasium building. The new structure is to be erected at 220 Jackson Ave., and will cost $22,000. Robertson, Power and Devey have been awarded the contract, while the plans were prepared by H. S. Griffith, architect.

Vanderhoof, B.C.—The International Editorial Association of Winnipeg are erecting a building here. Field secretary, Chas. C. Grant.

Victoria, B.C.—The School Board approved the plans of the new Oaklands School submitted by J. C. M. Keith, architect.

Victoria, B.C.—The Clarence Hotel Block, corner of Yates and Douglas Sts., has been sold by F. Landsberg to an eastern financial syndicate, and it is probable that important alterations will be made.

Weyburn, Sask.—Storey and Van Egmond, architects, Regina, are preparing plans for a rink to be erected here, and will call tenders shortly. Frame construction. Estimated cost, $25,000

Whitby, Ont.—The Nash Motor Co., Kenosha, Wis., is considering the establishment of a plant here.

Windsor, Ont.—A by-law has been passed by the city council providing for the issue of debentures to the amount of $15,000 for the purpose of purchasing a school site on the southerly side of Tecumseh Rd., and the construction and equipment of school buildings thereon. M. A. Dickinson, acting city clerk.

Windsor, Ont.—E. J. Clegg, of Walkerville, will shortly commence the construction of a new building on Ottawa St. The plans are for a two-story brick and concrete building, with a full-sized basement, 100 ft. in length by 31 ft. wide. When completed the structure will cost $30,000.

Windsor, Ont.—The Border Cities Co., Ltd., with offices at No. 1 Ouellette Ave., is building about 75 houses here, most of which are of solid construction.

Winnipeg, Man.—Fire recently destroyed a warehouse at the C.N.R. shops. Estimated loss, $100,000.

Winnipeg, Man.—Fire damaged the premises of the Ukrainian Publishing Co., 216 Dufferin Ave., to the extent of $30,000. The building is owned by the Canadian Bank of Commerce.

Winnipeg, Man.—Eighteen new branch bank buildings in Winnipeg and the west are being erected as follows: Canadian Bank of Commerce, eight branches, $134,000; Merchants Bank of Canada, three branches, $30,000; Bank of Hamilton, three branches, $57,000; Union Bank of Canada, four branches, $66,000.

York Tp., Ont.—During October nearly 200 building permits have been issued by Wm. Dever, building inspector. A permit was recently issued for a branch bank on the corner of Eglinton Ave. and Dufferin St.

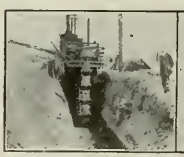
MISCELLANEOUS

Belleville, Ont.—Arrangements have been completed in this city for the location of the H. A. Wood Manufacturing Co., Ltd., for the production of high pressure valves under a new and improved patent.

Montreal, Que.—The "Canadian Navigator," the sixth vessel built by the Canadian Vickers, Ltd., for the government merchant marine, was successfully launched on October 18th, at the yards of the company at Maisonneuve. The vessel is about 4,350 tons dead weight.

Montreal, Que.—A new company, to be known as the Havana Marine Terminals, Ltd, with headquarters in this city, has been granted a charter by the Dominion government. The company is empowered to construct and purchase mills, shops, graving docks, warehouses and other necessary structures; to acquire all kinds of steam and sailing vessels, and generally to carry on the business of a navigation and transportation company. The company is capitalized at $30,000,000. Gordon MacDougall, K.C., is among the provisional directors.

Ottawa, Ont.—The following companies have been incorporated: Yeates Machinery and Supply Co., Ltd., Montreal, capital $100,000; the Barry Construction Co., Ltd., Ottawa, capital $50,000; Franco-British Country Elevators, Winnipeg, capital $100,000; Industrial Corporation, Ltd., Montreal, capital $600,000; West Coast Mining Co., Ltd., Toronto, capital $50,000; Peacock Brothers, Ltd., Montreal, capital $300,000; Save-U Gas Co., Ltd., Montreal, capital $100,000.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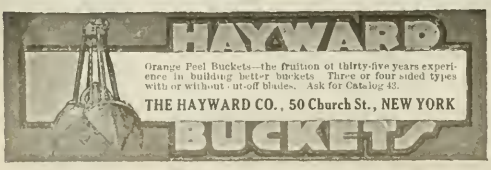
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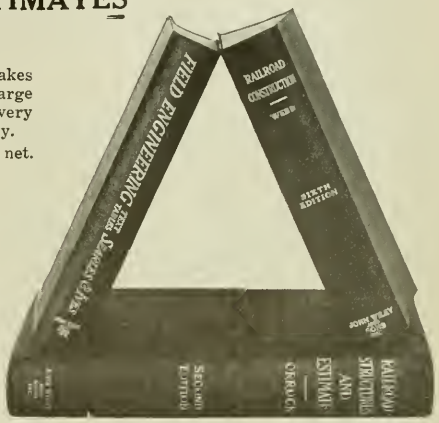

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C.E.—30-10-19

Sorel, Que.—Tenders addressed to R. C. Desrochers, secretary, department of public works, Ottawa, will be received until 12 o'clock noon, Friday, November 7, 1919, for the reconstruction of corner in concrete and other repairs to wharf at Sorel. Plans may be seen and specification obtained at the department of public works, Ottawa, at the offices of the district engineers, Shaughnessy Building, Montreal, Que., Post Office Building, Quebec, Que., and at the post office, Sorel, Que.

Sydney, N.S.—President Mark Workman, of the Dominion Steel Corporation, has announced the immediate undertaking of new submarine coal mining operations, with headquarters at Bonar Point, on the north side of Sydney harbor. The work is being undertaken for the purpose of supplying the high grade of metallurgical coal required for the manufacture of the steel to be used in the new plate mill, and foreshadowed important shipbuilding developments. The plans which have been prepared for the new workings involve the expenditure of approximately $2,000,000, and provide for the most modern equipment available.

Three Rivers, Que.—The Raymond Concrete Pile Co., Ltd., New Birks Building, Montreal, have been awarded a contract for piling for two additional shipways for the Three Rivers Shipyards.

Toronto, Ont.—Tenders, addressed to T. L. Church (Mayor), chairman, Board of Control, will be received up to noon on Tuesday, November 4th, 1919, for supplying 6,000 feet of 2½-inch fire hose. All information may be obtained upon application at the office of the Fire Department, No. 152 Adelaide Street West, Toronto.

Toronto, Ont.—G. L. Ridout, 73 Grosvenor St., Toronto, desires to rent a steam shovel and trenching machine, and is in the market for the purchase of drain tile. He has a contract for excavation and construction of new football field for Upper Canada College.

Victoria, B.C.—Two large and powerful motor boats are to be constructed by the marine department. Tenders will be called for shortly and the contract will be awarded early next month.

Winnipeg, Man.—The Pan Extension Gold Mines Co., Ltd., is negotiating for machinery, hoists, air compressors and a complete plant for installation at their property.

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COMMISSARY work for construction undertakings is my specialty. Before entering this line, I had eight years' experience as an accountant in the Canadian Bank of Commerce in Toronto and other Canadian cities. Am a Canadian, married, good references. During last year of war had entire charge of all feeding and living accommodations, timekeeping, etc., for large shipbuilding corporation in United States. Interview solicited. Address Box 398, *Canadian Engineer*, Toronto.

According to a circular received from Alfred D. Flinn, secretary of the U.S. Engineering Council, the following eleven states in the United States have laws on their statute books for licensing of engineers: Wyoming (Act passed in 1907), Louisiana (1908, amended 1914), California (1909), South Dakota (1913), Illinois (1915), Iowa (1919), Idaho (1915), Florida (1917), Oregan (1919), Colorado (1919) and Michigan (1919). As yet the U.S. Engineering Council has taken no stand on the desirability of licensing or registering of engineers, but the license committee is working on a draft of a typical bill.

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The Canadian Engineer

A Weekly Paper for Civil Engineers and Contractors

Effect of Water Uplift on Overturning of Dams

Theory Advanced That Water Pressure Acting Upward Replaces Portion of Foundation Reaction and That Its Overturning Effect Is Annulled by Counter Moment Produced by "Remaining Foundation Reaction"—Effect of Uplift Upon Sliding

By ERWIN MAERKER

Formerly Structural Engineer, Toronto Power Co.

THE method usually followed by engineers engaged in the design of dams (and other structures resisting water pressure), is to add the upward water pressure under a dam to the reaction of the foundation against the base of the dam, causing an additional overturning moment. The writer cannot agree with this theory, and he regards uplift as a force replacing part of the foundation reaction instead of adding to the foundation reaction.

It is not within the scope of this article to determine the amount and distribution of the uplift; that is, whether pressure due to the full head should be allowed at the heel of the dam, or a fraction thereof, or whether the pressure should diminish uniformly to zero at the toe of the dam, or vary according to a parabolic law or otherwise; but the article treats with the effect of the uplift assumed to act on the base of the dam.

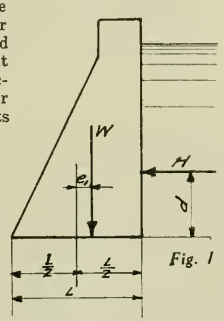


Fig. 1

Fig. 2

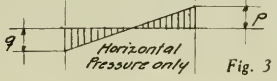


Fig. 3

Assume a block of masonry 20 ft. in height, with base dimensions of 1 by 15 ft., resting on its foundation. With a unit weight of masonry of 150 lbs. per cu. ft., the foundation reaction will be $20 \times 150 = 3{,}000$ lbs. per sq. ft.

For the sake of simplicity we will confine ourselves to vertical forces only, and omit horizontal water pressure, without in the least affecting the principle. Assume further a uniform upward water pressure of 1,000 lbs. per sq. ft., corresponding to a head of 16 ft., to act with equal intensity on the base of the block of masonry. Since the weight of the block of masonry produces a downward pressure of 3,000 lbs. per sq. ft. and the upward water pressure is only capable of exerting 1,000 lbs. per sq. ft., it is evident that the foundation reaction still in contact with the base of the block, must exert 2,000 lbs. per sq. ft. By increasing the uplift to 3,000 lbs. per sq. ft., the block will be entirely sustained by the interposed film of water between base of block and its foundation, and the block will be floating.

Fig 5 shows the uplift varying uniformly from 1,000 lbs. per sq. ft. at one extremity of the base to zero at the other extremity. The common error made is to regard the uplift as producing an overturning moment on the block, but the fact that the remaining foundation reaction is also producing an overturning moment counter to the moment of the uplift, is completely lost sight of. The two moments annul each other, and their total upward pressure is 3,000 lbs. per sq. ft., the upward water pressure substituting itself in place of the foundation reaction.

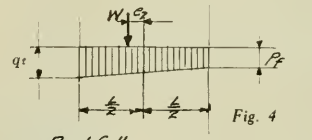


Fig. 4

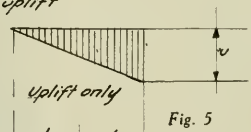


Fig. 5

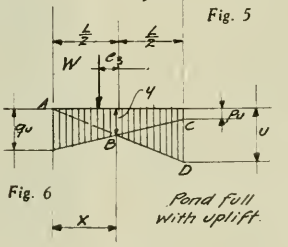


Fig. 6

How the uplift can be regarded as producing an overturning moment, and at the same time the counter-moment of the foundation reaction be wilfully neglected, is beyond the writer's comprehension. It is a case of mechanics, pure and simple.

Lamar Lyndon, in his first volume on "Hydro - Electric Power," speaking of this added overturning moment, writes:—

"How such a weird fancy could have ever obtained the importance of a standard engineering rule of design, is beyond the writer to understand, being contrary to every law of physics, mechanics and common sense."

In case the uplift exceeds the foundation reaction at the heel of the dam, there will be an excess pressure acting upward, and it is this excess pressure only which will have to be considered as producing an overturning moment. The following equations will make this clear:—

Let W = Weight of dam per foot of length.
H = Horizontal water pressure.
L = Length of base.
d = Distance of H above base of dam.
e_1, e_2, e_3 = Eccentricity.
p = Pressure at heel of dam.

q = Pressure at toe of dam.
u = Uplift at heel of dam.
W_u = Weight of dam per foot of length, diminished by excess uplift.

Subscripts e, f and u refer to "pond empty," "pond full" and "pond full with uplift," respectively.

Foundation Reaction, Pond Empty.—Pressure on foundation due to direct load plus or minus couple $W \times e_1$. See Fig. 2.

$$p_e = (W/L)(1+6e_1/L) \quad \ldots\ldots(1)$$
$$q_e = (W/L)(1-6e_1/L) \quad \ldots\ldots(2)$$

Foundation Reaction, Pond Full, No Uplift.—See Figs. 3 and 4. $Hd = pL^2/6 = qL^2/6$. Solving for p and q:—

$$p = q = 6Hd/L^2 \quad \ldots\ldots(3)$$
$$p_f = p_e - p \quad \ldots\ldots(4)$$
$$q_f = q_e + q \quad \ldots\ldots(5)$$

Also,
$$p_f = (W/L)(1-6e_2/L) \quad \ldots\ldots(6)$$
$$q_f = (W/L)(1+6e_2/L) \quad \ldots\ldots(7)$$

From this,
$$e_2 = (Hd/W) - e_1 \quad \ldots\ldots(8)$$

Foundation Reaction, Pond Full, With Uplift.—When $u \leqq p_f$, no change results due to uplift, as far as overturning moment is concerned, and equations 4 and 5 are to be used. For sliding, however, subtract $uL/2$ from W, since only that part of the dam which is in actual contact with the foundation produces friction.

When $u > p_f$ the procedure is as follows: The excess uplift BCD in Fig. 6 causes foundation reaction in Fig. 4, namely p_f and q_f, to change to p_u and q_u respectively in Fig. 6, so as to make the sum of all moments equal zero and the sum of all vertical forces equal zero.

Taking moments about A (see Fig. 6),
$$W(L/2-e_2) = uL^2/3 + (q_u x/2)(x/3).$$
But $W = uL/2 + q_u x/2$, and solving for x,
$$x = [6W(L/2-e_2) - 2uL^2]/(2W-uL) \quad \ldots\ldots(9)$$
And
$$q_u = (2W-uL)/x$$
$$= (2W-uL)^2/[6W(L/2-e_2) - 2uL^2] \quad \ldots\ldots(10)$$

From similar triangles:—
$$u/L = y/x, \text{ and } y = ux/L.$$
Also
$$(q_u - p_u)/L = (y-p_u)/(L-x).$$
And from these two equations,
$$p_u = u - q_u[(L-x)/x] \quad \ldots\ldots(11)$$
$$W - \Delta BCD = W_u = \tfrac{1}{2}(p_u+q_u)L \quad \ldots\ldots(12)$$
Since $q_u = (W_u/L)(1+6e_2/L)$,
and $p_u = (W_u/L)(1-6e_2/L)$,
$$e_2 = \tfrac{1}{6}L(q_u - p_u)/(q_u + p_u) \quad \ldots\ldots(13)$$
When $p_u = 0$, $e_2 = L/6$.

For sliding, subtract $\frac{1}{2}uL$ from W.

In conclusion it will be said that the uplift is usually assumed much larger than necessary. If a horizontal plane be cut through the base of the dam, the area of the voids in practice would not exceed 25% of the total area, except under extraordinary conditions, and since the water could only fill these voids, the unit uplift pressure exerted could only be 25% of the pressure assumed. The unit pressure of the dam against the foundation would then be $1 \div 0.75 = 133\%$ of the actual contact area, since only 75% of the base area would come in contact with the foundation.

PRESSURES IN PENSTOCKS CAUSED BY THE GRADUAL CLOSING OF TURBINE GATES*

By William P. Creager
Assistant Hydraulic Engineer, J. G. White Engineering Corporation, New York City

THE theory of water-hammer in penstocks is one of the most intricate problems confronting engineers. Mr. Gibson has made a considerable addition to the knowledge of the subject; but exact solutions for all conditions have not yet been reached.

He has developed rational equations for penstocks of constant diameter and negligible friction head. In cases where friction head is relatively large, and particularly where the penstock has a varying diameter, we are still very far from a practical solution.

At any instant during gate closure, the discharge through the gate is a function of the static head, plus water-hammer head, less friction head, all measured at the gate.

Mr. Gibson makes the assumption that the friction head at the gate is proportional to the square of the velocity adjacent to the gate. This assumption appears to the writer to be only approximate, since it is well known that, at any instant during surges, the velocity is materially different at different points on the penstock.

It is the writer's opinion that, during the period $2L/a$, subsequent to a single small instantaneous closure, the friction head at the gate is not constant, although the velocity adjacent to the gate during that period is constant. This constantly varying friction head makes it very difficult to include this feature in the equations for water-hammer, and, in all probability, Mr. Gibson's methods are as close as can be obtained. It would be of interest to know how much difference the incorporation of friction head makes in ordinary problems.

For a penstock with varying diameter, auxiliary waves are set up each time a water-hammer wave passes a point of change in diameter. For this condition, Mr. Gibson's equations would not apply. His methods would apply, but they would be exceedingly difficult, if not impossible, of practical application.

It is evident that the maximum rise of pressure is materially influenced by the characteristics of the gate-closure curve. It is well known that modern turbine governors do not provide a uniform rate of gate closure throughout the stroke. It is also possible that governors of different types have different closure characteristics. Consequently, complete data for the determination of maximum water-hammer for specific cases must include the gate-closure characteristics of the governor, which is to be a part of the machinery.

*Discussion (presented to the American Society of Civil Engineers) of Norman R. Gibson's paper (see September 4th and 11th issues of *The Canadian Engineer*).

TO CONSIDER PAY FOR ESTIMATES

TENTATIVE arrangements have been made for a conference to be attended by committees from the American Institute of Architects, the U.S. Engineering Council, and the Associated General Contractors of America, for the purpose of considering "payment for estimating." At present it is planned to hold the first meeting November 17th at Hotel La Salle, Chicago.

For the Associated General Contractors, a special committee has been appointed, consisting of the following: A. P. Greensfelder, of the Fruin-Colnon Contracting Co., St. Louis; James O. Heyworth, of the Chicago company of that name; and A. E. Wells, of the Wells Brothers Construction Co., Chicago. Mr. Greensfelder is the chairman of the A.G.C.'s Committee on Methods, which had general supervision of the discussions regarding "payment for estimating."

Engineering Council has named as its delegates, Ralph Modjeski, Samuel G. Neiler and Theodore L. Condron, while the Post-War Committee of the American Institute of Architects will be represented by George C. Nimmons, Richard E. Schmidt and Frederick W. Perkins, with Henry K. Holsman as alternate.

In a report recently made by F. A. Gaby, chief engineer of the Hydro-Electric Power Commission of Ontario, the estimated cost of the proposed hydro-radial from Toronto to Bowmanville, via Pickering, Whitby and Oshawa, is given as $8,360,794; the estimated annual revenue, $1,118,003; and the estimated annual operating expenses, including 5% interest on capital expenditure, $1,076,175. Of the $1,118,003 income, $873,140 is expected from passenger traffic and $244,863 from freight.

HOUSING AND TOWN PLANNING*

By Thomas Adams
Town Planning Adviser to the Dominion Cabinet

WE have a great opportunity in Canada to make our housing conditions right, because it is a new country. In older countries, like England, attention is being devoted to the solution of a housing problem that arises from bad conditions which we can prevent in this country. It is obviously a much easier operation to prevent bad conditions than it is to remedy them after they have become established.

Some idea of the enormous problem that they have to deal with in England may be gathered from the fact that they propose to build under government agency from 300,000 to 400,000 houses at a cost of from $2,500 to $4,000 each, involving a loss to the country—when they come to make up the difference between the cost of the houses and their value as an investment, likely to result from the fall in prices which will take place in a few years—of several hundred million dollars.

They are facing this loss at a time when they have not very much money to spare for anything which is not an absolute necessity. That is because the problem in England has been neglected too long. Here in Canada we are still in the formative stage as a country. Rapid as our growth has been, great as has been the development in the last 20 years, still our biggest housing problem is to prevent bad conditions of growth in the future rather than to correct the evils of the past.

We have a chance to prevent such a catastrophe as that of handing down to the future citizens of this country the evils that are characteristic of the slums of older European cities. We cannot delude ourselves with the idea that we have not begun to create the germs of slums in our big cities. Without a doubt the conditions already existing in our few big cities are comparable with some of the worst conditions in European cities. These existing evils must be attacked and some remedy found for them, but it is still true that with us the greater task and the greater responsibility is to prevent the further growth of these evils by preventive measures.

Workmen's Cottages at Gretna

In both Canada and the United States we have the beginnings of slums, and we have a similarity of conditions that enables us to compare them to our mutual advantage. One of the things of which housing experts and town planners are convinced is that the solution of the housing problem depends most largely on applying right methods of planning and developing the land, and on the extent to which these methods lessen the evils that arise from land speculation.

One of our chief tasks is the prevention of bad conditions in the new suburbs of our cities, without diminishing our efforts to remove the evils prevailing in the centres of the cities. All our cities are surrounded by scattered and somewhat disorderly developments, and one difference between a Canadian city and a city, say, in the Mother Country, is that whereas our new suburban developments are among the worst we have, the bad housing conditions in the English city have been mostly handed down from the past. With us, some of the worst conditions are those which we are creating to-day, in the form of unsanitary shacks in the suburbs of our cities. If you want to see the worst conditions in Ottawa, for instance, you must go not to "Lower Town," or to the centre of the city, but just over the city boundaries, in what is practically a "no man's land," between the city and the country, and where there is a lack of sufficient control and interest to secure proper conditions.

Government Housing Scheme at Well Hall, Woolwich

Garden City at Letchworth

One of the movements in England of great interest to housing reformers is the Garden City at Letchworth, near London. It proves the advantage of town planning as a basis for practical housing improvement. If there is any experience in my own life which I look back upon as having the most value to me as a town planner, it is the experience I had during the few years that I was connected with the building up of that garden city. We started *de novo*; we considered the problem right from the beginning and commenced the building of a new city unhampered by existing vested interests. That scheme was started for the purpose of establishing certain principles and to take advantage of a prevailing tendency of manufacturing industries to migrate from large centres of population to rural districts, a tendency which is very prevalent in this country also.

Industrial Decentralization

I have just been making some investigations in connection with housing conditions in Toronto, and one of the things we are inquiring into is the extent to which the movement of industrial plants from the city proper out into

*Address delivered October 18th, 1919, at the Ottawa Conference of the American City Planning Institute and the Town Planning Institute of Canada.

the suburbs has affected the housing situation. You would be surprised to know how many industries have moved out of the central districts of Toronto, within the last few years, into the suburbs, where they have created a new demand for houses and new questions of transportation.

These industries have been moved into districts where they can get cheap land and transportation facilities, but adequate consideration has not been given to the question of housing for the workers.

This problem of the decentralization of industry has been in existence for the last 20 or 30 years in Britain. Big industries have been moving out of London and other large centres to the country districts, and the originators of the Garden City movement said:—

"Let us take hold of this movement. Let us start a new city and offer attractions to these industries that are looking for new locations. Let us group these manufacturers together and build houses for their employees. Let us give them up-to-date transportation and other facilities. Let us conserve the whole of the unearned increment of the value of the land created by the inhabitants for their own benefit; and see if we can establish a city which will be a model in connection with both the housing question and the land question."

Well, they have been comparatively successful: 3,800 acres were purchased at about $200 an acre. The promoters planned the site of the city, they put in an electrical installation, gas works and a pure water supply. They prescribed that there should not be more than seven or eight houses to the acre. They put all the industries in one part of the estate, where the prevailing winds took the smoke away from the town. They improved the transportation system. The worker in Garden City lives within five minutes' walk of his place of employment; no costly transportation system takes him from a point ten miles out in the suburbs to a plant in the centre of the city, requiring him to spend two or three hours a day in going to and from his work.

Planning Increases Working Time

I venture to suggest, in connection with the discussions that took place at the recent National Industrial Conference, that this is one of the matters which has a distinct bearing upon the number of hours a day that an employee can reasonably give to his work. Every year we are increasing the aggregate distance between the factory and the home of the worker. A man may work eight or nine hours a day in a factory, but if he spends two or three hours a day hanging on to a strap, going to and from his work, he is going to continue pressing for the reduction of the time he gives to productive forms of labor, and is going to continue to be a less efficient instrument of production than if he lived near his place of employment. So this very question of the number of hours that the workman wastes each day in unnecessary travelling, as a result of unregulated distribution of industries and population, has a definite bearing upon the question of efficiency and output of labor.

We cannot repeat the Letchworth experiment all over the country, but if we had in Canada a place where manufacturers were already moving and where we could organize such an industrial development, it would be an excellent thing. It would have a great value in demonstrating the efficiency of scientific organization and of planning for the purposes of solving the housing problem, the land problem and the transportation problem, and of promoting industrial efficiency.

Unearned Increment Reserved

In the Letchworth scheme, the unearned increment in the value of the land is conserved for the benefit of the community. I have said that the land for the Letchworth garden city was purchased at $200 an acre. The value of that land has now increased to $1,000 and $2,000 an acre, and the whole of that increase in value is conserved for the benefit of the inhabitants of Letchworth. There can be no private property in land in Letchworth. You can acquire a lease for 99 years, with the right to renew at the end of that period, subject to revaluation, but you cannot acquire private property in land.

The land was purchased by a company, as a trust for the inhabitants, which laid down the conditions that the whole of the increase of value due to the conversion of the land from agricultural to building purposes, should be conserved for the benefit of the community. But it has to be pointed out that the people of Letchworth have been able to make their largest profits in the earlier years of development on account of the efficiency with which they are able to distribute gas, electricity, water and the other necessities of life, because of proper planning. The control of these things is often handed over, without thought, by franchise, to private concerns.

Agricultural Belt

An important and interesting feature of the Garden City scheme is the agricultural belt round the city. The city area comprises about 1,200 acres, laid out for a population of 30,000 people. In this area there are at present about 30 factories and 13,000 people. In 1903 there were about half a dozen farm houses and laborers' cottages on the site of the city. The other 2,600 acres of the original area, with an additional 700 acres recently acquired, are reserved as a permanent agricultural belt round the city. The charter under which the city is established provides that this belt must be reserved permanently for agricultural purposes or for such recreation purposes as golf. Thus the inhabitants have a large open area all round the city which can never be built upon, and the produce is brought close to the door of the consumer. If the city increases its population over 30,000, it must extend by leaping over the agricultural belt. Thus the industry of farming is linked up with manufacturing industries in one community, avoiding the usual separation of town and country into two distinct zones with the inhabitants of each pulling against one another. The city of the future should have its farm zone, with more harmonious relations established between the workers on the farm and in the factory. Letchworth proves the practicability of the combination, and in contrast the cities of this continent show the evils that arise from the excessive degree to which they promote the separation between agriculture and manufacture.

Letchworth a Private Experiment

People are apt to assume that model housing schemes can only be carried out by philanthropists and governments with unlimited resources. The Letchworth experiment was initiated by a number of men, including Ebenezer Howard, the founder; the late Sir Ralph Neville, a judge; George Cadbury; and Alfred Harmsworth, as he then was, now proprietor of "The Times," who put a little money into the scheme at the start.

Altogether, we had little more than $500,000 when we started out to build that town. The whole of the capital that has been raised in connection with it does not amount to more than $3,000,000. That money is now beginning to receive dividends which are limited to 5%.

The main point I wish to make about Letchworth, as an illustration of practical housing, is that when you do a thing properly; when you apply social science to the development of the social forces of industry as you apply physical science to the actual operations of your industrial plants, you can secure equally good results.

In other words, the way to bring about good results in connection with housing is to do the thing in the right way, although it needs more courage, vision and trouble at the outset. I think that is one of the things we have to learn in connection with our housing experiments in Canada, if we are to be practical: That it is far better to do the thing in the right way, even if at first it appears to be more costly.

Hampstead Garden Suburb

Hampstead is a suburb of London. The Hampstead Garden Suburb is the creation of a woman, Mrs. Barnett, wife of Canon Barnett, who spent a great many years in the east of London, and came to the conclusion that the way to solve the housing problem in the slums was to get the people out into the country, out into the suburbs. So she

built a garden village at Hampstead, where she mixed the rich and the poor; for, as she said, it was as much for the benefit of the one as of the other.

Well Hall Model Village

At Well Hall, near Woolwich, there was built during the war a town of 6,000 people. This town, which was built in 1915, was brought into being and occupied within nine months, this by the slow English people at a time when the whole organization of the country was devoted to the manufacture of munitions of war, the raising and transportation of troops, and other war purposes. This and other schemes were carried out as the result of investigations made under Lloyd George, who wanted to find out how to increase the output of munitions. It was decided that to ensure reasonable hours of labor, comparatively good pay and, above all, good homes and contentment on the part of the worker, so far as his living conditions were concerned, was the best way to increase output.

If it is sound policy to build good houses and provide pleasant surroundings for workmen in the middle of a war in order to increase the output of munitions, it is just as sound a policy to provide good conditions and good surroundings and to bring about contentment among our workers in order to increase the output of production to meet competition with other countries in time of peace.

Practical in Peace-time Also

Under the war strain the British people were working at high pressure, and it would not have been unnatural to say to the people that, as patriots, they should be content with conditions that were unpleasant or unfavorable in the matter of housing. But it was considered to be better, even in time of war, to follow the bold policy of building permanent and healthy homes with agreeable surroundings.

What is wanted in the development of modern industry is not so much physical strength as nervous energy on the part of the worker, nervous energy and mental capacity to manipulate complicated machinery and to deal with difficult mechanical processes.

It is more important than ever before that we should have the worker living under conditions that will cause him to be contented and that will enable him to give the greatest efficiency to his work.

And in this respect the Well Hall experiment has a lesson for us. If it is good practical policy to build garden villages in time of war, it is equally a good practical policy to build garden villages and to improve housing conditions in times of peace.

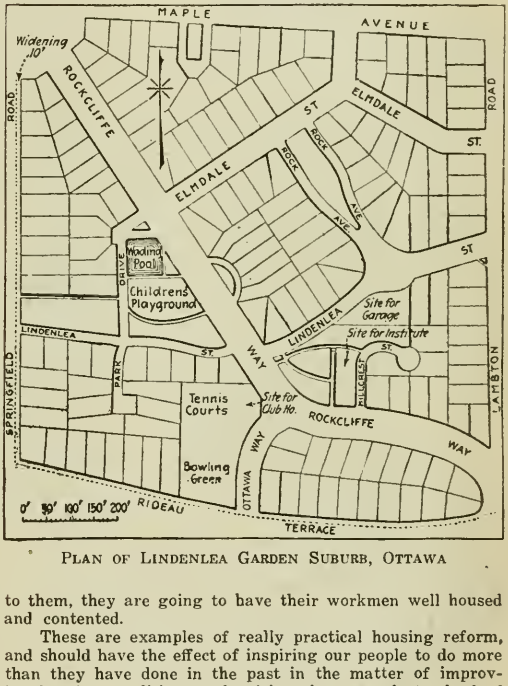
Therefore, I think we may congratulate ourselves upon the fact that the government of Canada and the provincial governments have taken the initiative in the matter of housing, with a view to dealing with the problem in the right way. Loans are made to the provinces for housing purposes. In this connection Ontario and its municipalities are heartily co-operating with a view to improving housing conditions. I am not going to deal here with the Canadian situation. I am simply trying to establish the value of good, sound methods of development as the really practical way of solving the housing question.

Inspiring Examples in Canada

I have endeavoured to illustrate some of the good examples of practical housing with the idea of suggesting to those who are dealing with this matter that they take no half-way measures, but go in for real, substantial improvements in the matter of raising the standards of housing accommodation. We are face to face with this condition in modern times: Men demand higher standards of housing at a time when costs are high, when labor and materials are expensive. But we must face that difficulty and try, by greater efficiency, to attain these high standards. We have to remember that to the extent to which we provide proper conditions, men will have greater earning power, and there will be greater efficiency and increased production.

I hope that the citing of these examples of British conditions has not produced the impression that I have endeavoured to contrast them with our bad conditions in Canada. We need the inspiration of what the "mother country" is doing to solve this problem; and we can take to heart the fact that in Letchworth, Hampstead and Well Hall, England has demonstrated one or two methods of dealing with the problem which are worthy of our consideration here. We have in Canada, as in the case of Grand 'Mere, Kipawa and Lindenlea (Ottawa), examples of proper attention to this subject which are equally good and equally inspiring.

At Lindenlea, Ottawa, we are carrying out a housing scheme under the Ontario Housing Act. At Lindenlea it has been proved that planning pays, and that when the land is properly planned great economies can be effected and ample recreation spaces provided. I think we shall be able to create there a suburb of Ottawa that will also be worthy of citing as an example. At Kipawa, on the Timiskaming river, the Riordon Pulp & Paper Co. are building a model town, which, I think, will also be an excellent example. Their houses for workmen are costing from $4,000 to $6,000. They have already erected 30 houses and are proceeding to build more. They are not content with shacks; they are not content with cheap houses; they recognize that even if it means a loss



PLAN OF LINDENLEA GARDEN SUBURB, OTTAWA

to them, they are going to have their workmen well housed and contented.

These are examples of really practical housing reform, and should have the effect of inspiring our people to do more than they have done in the past in the matter of improving housing conditions and raising the general standard of living among our working people.

[NOTE.—The land for Lindenlea was bought by the Ottawa Housing Commission, and the "garden suburb" was laid out under Mr. Adams' direction. Most of the houses will be detached and they will be erected on lots having a frontage of from 30 to 60 ft. The tract of land acquired has an area of about 22½ acres, and of this over 2½ acres, or fully 10%, has been set aside for parks, playgrounds and other open spaces, including sites for a community garage and an institute. There are 168 available housing sites. The land is somewhat rocky. The street system and lot subdivisions have been planned to effect economy in street construction as well as with an eye to the best possible appearance. As shown by the accompanying plan, there is a principal street, called Rockcliffe Way, laid out as a diagonal thoroughfare. This is 66 ft. wide along its entire length. Near one end there is a short connecting road called Ottawa

Way, from which a good view may be had of the Parliament building. The minor streets are of less width, varying with the probable future traffic, and are so laid out that for the most part the lots are regular in shape, although not always rectangular. Mr. Adams states that the total cost of the land was about $66,000. Incidental expenses of some $15,000 will be incurred. Streets will be macadamized to a width of 14 to 16 ft., and it is expected that this work will be done by the city. The lots are being sold for $340 to $600 each, or 12.8c. per square foot on the average, with a range of from 10 to 15c. Lots fronting on Rideau Terrace, which has already been provided with partial improvements, have been sold at an added price of 75c. a front foot. Most of the trees will be preserved. An effort is being made to ensure the placing of electric and telephone wires at the rear of the dwellings, so that the streets will be kept free from poles. This will mean that the street lighting will have to be arranged by underground wiring, which can be carried out inexpensively as compared with underground wiring for electric services to the dwellings.—EDITOR.]

Experiments Show Effect of Fineness of Cement

Results of Over 6,000 Tests of Concrete Cylinders, 9,000 Compression and Tension Tests of Mortar, and Several Thousand Miscellaneous Tests —Summary of Paper Presented to American Society for Testing Materials

By DUFF A. ABRAMS

Professor-in-Charge, Structural Materials Research Laboratory, Lewis Institute, Chicago

RECENT revision of the standard specifications for portland cement served to focus the attention of engineers on the function of fineness of grinding of cement in producing concrete of high strength and other desirable properties. An investigation of this subject has been under way at Lewis Institute for the past four years. Five series of tests have been completed; another series is now under way. These studies were made as a part of the investigations of concrete and concrete materials being carried out through the co-operation of the Portland Cement Association and the Lewis Institute at the Structural Materials Research Laboratory.

The portland cements used were from seven commercial mills. These plants represent the principal cement-producing districts east of the Mississippi River. Fifty-one different samples of cement were used. The cements were ground at the mill to four to seven degrees of fineness, which gave residues ranging from 2 to 43% on the standard 200-mesh sieve. In general, the aggregate consisted of sand and pebbles; in one series blast furnace slag and a light-weight aggregate consisting of burnt shale were used.

Nine Subjects Investigated

This paper covers compression tests on 6,125 (6 by 12-in.) concrete cylinders, 9,000 compression and tension tests of mortar, and several thousand miscellaneous tests. Strength tests of concrete and mortar were made at ages of seven days to one year.

Definite information has been secured on the effect of fineness of cement under the following conditions:—

(a) Effect of fineness of cement on the strength of concrete.
(b) Quality of concrete, using different cements.
(c) Effect of the quantity of cement used.
(d) Effect of consistency of the concrete.
(e) Effect of size and grading of the aggregate.
(f) Variation in the type of aggregate.
(g) Effect of age of concrete.
(h) Elongation and contraction of concrete.
(i) Effect of fineness of cement on workability of concrete.

The following may be stated as the principal conclusions from the tests:—

1.—There is no necessary relation between the strength of concrete and the fineness of the cement if different cements are considered.

2.—In general, the strength of concrete increases with the fineness of a given lot of cement, for all mixes, consistencies, gradings of the aggregate and ages of concrete. The cements with residues lower than about 10% were inclined to give erratic results in the strength tests. One lot showed an abnormal increase and two others a pronounced decrease in strength, as compared with the other tests on coarser cements in the same lot.

3. For residues higher than 10%, the strength of concrete varies approximately inversely as the residue on the 200-mesh sieve.

4.—Fine grinding of cement is more effective in increasing the strength of lean mixtures than rich ones.

5.—Fine grinding of cement is more effective in increasing the 7-day strength of concrete than at ages of 28 days to 1 year.

6.—For the usual range of consistencies, the effect of fineness of cement is independent of the consistency of the concrete. The rate of increase in strength with fineness is lowered for very wet mixtures.

7.—Ordinary concrete mixtures at 28 days show an increase in strength of about 2% for 1% reduction in the residue of the cement on the 200-mesh sieve. At 7 days, 3 months and 1 year the corresponding increases in strength are about 2.5%, 1.7% and 1.4%.

8.—The decreased benefit of fine grinding of cement with the age of the concrete does not bear out accepted opinion that the coarser particles of cement do not hydrate, but indicates that the principal result of finer grinding is to hasten the early hardening of the concrete.

9.—For the richer mixtures and the consistency necessary for building construction, the fineness of the cement has no appreciable effect on the workability of concrete as determined by the "slump" test. For leaner mixtures and wetter consistencies, the finer cements showed a somewhat greater "slump" than the coarser cements.

10.—The normal consistency of cement is increased with fineness of grinding. About 0.1% of water (in terms of the weight of the cement) must be added for each 1% reduction in residue on the 200-mesh sieve.

11.—The time of setting of the cement is shortened with finer grinding. In some instances initial setting time with the Vicat needle was shortened to 5 to 10 minutes.

No Effect on Density

12.—The unit weight of cement decreases with fineness. For the cements used in these tests the weight varied from 76 (residue of 2.4%) to 108 lbs. per cu. ft. (residue 43.3%). For the usual range in fineness, the weight is lowered about ¾ lb. per cu. ft. for each 1% reduction in the residue on the 200-mesh sieve.

13.—In using 94 lbs. per cu. ft. as a uniform basis for proportioning the cements in these tests, the actual volume of cement in a batch *of the same mix* varies about 35%. If the mixtures had been proportioned in a manner that would have given a uniform *volume* of cement, the resulting concrete strength would not have been so favorable to the finer cements.

14.—The fineness of cement has no appreciable effect on the yield or density of concrete.

(Concluded on page 448)

BELLEVILLE, ONT., WATER SUPPLY*

PRIOR to 1918 the city of Belleville, Ont., with a population of about 13,000, was supplied with water by two steam pumps and one electrically operated pump, the latter being used only for domestic supply. On account of the growing demand for water, the increased cost of pumping and the condition of the steam pumps, which had been operating many years, it was decided to install new electric pumps and as soon as a duplicate transmission line could be built to the pumping station, to discard all the old pumping equipment.

The pumping station is west of the Moira river (which flows through the centre of the city) and is about one mile from the central business district. The supply is pumped through a single 16-in. main, about one mile long, to a standpipe of 360,000 gals. capacity and to the distributing mains. In the new layout, provision was made for a duplicate 16-in. supply main to be installed at a later date.

In order to properly accommodate the new electric pumps and control apparatus, the old steam pump room was enlarged and provision was made for placing the starters from the motors on a gallery to which was also carried the main valve stems and valves in the priming piping. This gallery extends around the sides of the pump room. On the back wall of the gallery is mounted the 550-volt bus disconnecting switches, meters, etc. The bus is sectional so that normally some of the pumps can be fed off one circuit and some off the other, or if necessary all the pumps can be fed off either circuit.

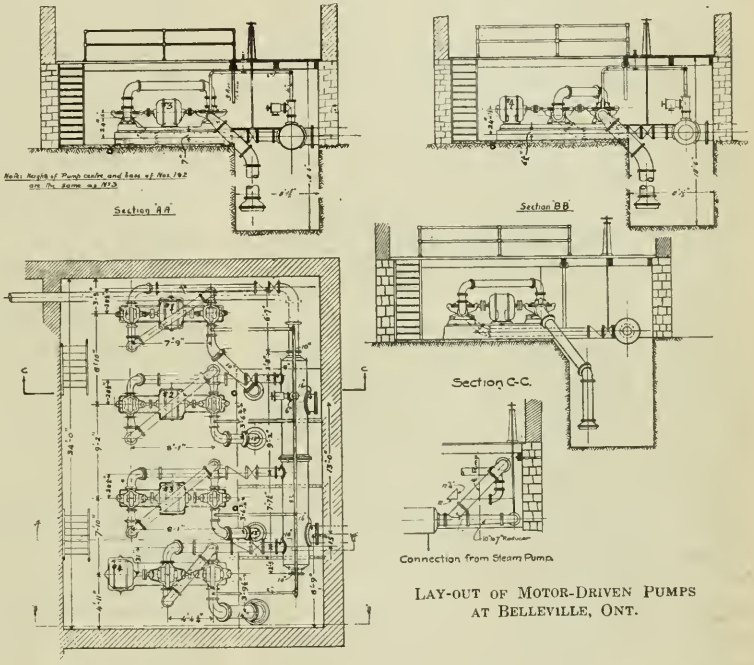
There are four pumps, one of 800 gals., driven by a 100-h.p., 3-phase, 60-cycle, 550-volt, 1,800 r.p.m., induction motor; two of 1,100 gals., each driven by a 125-h.p. motor; and one of 1,560 gals., driven by a 150-h.p. motor. All the motors are of the squirrel cage type. The pumps are designed to operate most efficiently at a head of 250 ft. (108 lbs.). They are also designed to deliver about two-thirds their normal capacities at a head of 325 ft. (141 lbs.) for fire purposes, this high pressure being required to overcome the friction in the long 16-in. main and still give ample pressure in the central business district. The small deficiency in volume for fire service can be made up by the future addition of pumps driven by gasoline engines. The pumps are all two-stage split-stage type; that is, two single-stage pumps connected in series, with the motor in the centre except in the case of the largest pump, where the motor is at one end.

The intake, which extends some distance into the Bay of Quinte, delivers through screens to a suction well in the pump room, from which the pumps discharge to a steel header located at the top of the suction well. The present 16-in. delivery main is connected near one end of this header and provision has been made for connecting a future 16-in. delivery main near the opposite end. All the water pumped is measured with a Venturi meter.

Preliminary plans have been drawn providing for a new intake and suction well from which low-lift electric pumps will deliver the water to rapid sand filters, which in turn will discharge to a clear water reservoir and to the present well.

When deciding upon the head and other characteristics of these pumps, and the location and type of electrical equipment, consideration was given to the possibility of using the pumps and equipment in a more complete water treating and pumping plant.

The transformers by which 550-volt service could be supplied to the present or future pumps from lines operating "Y" or delta connected, have been located temporarily on a pole-type structure just outside the pump house. Permanent installation of this equipment will be decided upon when a more adequate water treating and purifying system is being installed. Two independent power lines are being built to serve this station.



LAY-OUT OF MOTOR-DRIVEN PUMPS AT BELLEVILLE, ONT.

A comparison of the cost of pumping for 1916 and 1919 shows a saving for 1919 of $750. Part of the domestic pumping in 1916 was handled by the old electric pump and the remainder by steam, 600 tons of coal at $4.75 per ton being used. In 1919 all the pumping was done by the electric pumps.

*From the October, 1919, Bulletin of the Hydro-Electric Power Commission of Ontario.

The Engineers' Club of Peterborough, Ont., will hold a dinner this evening at the Empress Hotel, Peterborough. After the dinner the club loses its identity and becomes the Peterborough branch of the Engineering Institute of Canada. This dinner will therefore mark the inauguration of the new branch as well as the termination of the old club.

Sir Adam Beck was heartily endorsed last week at a meeting of the Municipal Hydro-Electric Association of Ontario, and he was urged to continue as "Hydro" chairman. Sir Adam had threatened to resign on account of his defeat in the recent provincial election, as he thought that the "Hydro" chairman should be a member of the legislature. The Association stated that a seat would be found for him, and urged Sir Adam so strongly to continue his work that he found it impossible to resist the popular pressure upon him to remain in office.

FINANCIAL STATEMENTS AN AID IN PROCURING CONTRACTS*

By Daniel J. Hauer
Construction Economist

A DECADE or two ago, a contractor who had just finished a large contract upon which no money had been made, and with his plant or outfit tied up so he could not move it, put about $250 in his pocket and went into an adjoining state to procure a new contract and get another start in his business. By sheer force of character and keen judgment, together with diplomacy in talking to and handling the engineer and other officials of the company letting it, he obtained a contract for more than half a million dollars of work. With this as an asset he was able to borrow ample money to get the job under way quickly.

A number of such examples of securing valuable contracts with little or no capital, and carrying them to completion upon a shoestring, could be cited from the experience of the writer and his friends. It still can be done in some cases, but it is the exception to-day rather than the rule.

Financial Responsibility Now Necessary

The first step in obtaining a contract under present-day conditions is a matter of finance, a setting forth of the contractor's assets. Certified cheques must be used for bidding, bonds made to qualify before figuring, and for some public contracts a certificate must be furnished before bidding that a bonding company will make bond should the contractor get the job. There are even cases in which a contractor must show his responsibility to the owner before the contract is awarded.

Finances thus become the basis of procuring nearly all contracts, and this means that the modern contractor must look closely after his financial standing in the business world. With ample capital this is seemingly an easy matter, yet many contractors who possess large capital do not always enjoy the best of credit or possess the financial standing of those with less means, due to the fact that they are not careful of their credit, and think they are always likely to be in a position of meeting their obligations with ease.

Benjamin Franklin told how he borrowed money and built up his credit when he did not need money and could pay cash, in order to have a good line of credit extended to him when his needs were urgent. This is a valuable lesson in which all contractors can find profit.

Credit is obtained by two methods to-day. One is by means of statements showing assets and liabilities, thus disclosing the net worth of a growing concern. The second method is by means of references. In this last, personal integrity and the esteem and confidence in which a man is held counts for much. In most cases these two methods go hand-in-hand, and the second is frequently the result of the first. In spite of this it is quite surprising how many contractors refuse to make statements of their financial condition.

Even Large Contractors Borrow

Only recently, as the writer was giving a statement to the solicitor of one of the large national mercantile agencies, the solicitor remarked upon the fact that a large per cent. of contractors refused to make statements, with the result that their standing was greatly reduced and their credit limited. Definite knowledge of a man's standing, even though he has only a few thousand dollars, has been proved better than meagre information regarding a man who may be worth more.

Take the question of deposits on bids, for example. If the cheque is only a few hundred dollars, almost any contractor can furnish it, but if some thousands are demanded, even the contractor who is conducting a large business may not be able to spare the sum, and must arrange to borrow the money. As this is written, an eastern state is asking for a $25,000 certified cheque with a bid. Even if a bidding bond is used instead of a certified cheque, the bonding company will want to know the financial condition of the applicant.

This likewise is true if a bond must be obtained when a contract has been awarded. If there is a maintenance clause or guarantee to the contract, the bonding company will want to know if the contractor is financially strong enough to live up to the contract he is about to make.

If the engineer, architect or owner is careful to whom he lets work, a close investigation will be made of the standing and reputation of the successful bidder. In some cases this is done before bids are asked from contractors. The only way to meet this demand for information is to have carefully prepared reports of a contractor's standing in the hands of commerical agencies and of his banker. A great saving of time will thus be effected.

Money frequently must be borrowed from banks to start new contracts, and if close relations are to be maintained with a banker he will demand information in regard to the general business policy of the contractor and what his net worth is from time to time. Some people are not favorably impressed with bank references, while others prefer them. In many cases large contracts have been captured by aid of letters from bankers saying the contractor was able to handle the transaction, or else that they were willing to give him financial assistance. In many cases during the world-war, the national government demanded information from contractors and their bankers before awarding contracts.

Lost Municipal Paving Contract

There is a growing tendency among state and city governments to look into such details, and some few are asking for this information direct from the contractor. On the other hand, most of this information is gleaned from outside sources, and frequently to the detriment of the contractor. Only during last spring the writer knew of a city refusing to award a paving contract to the lowest bidder on account of meagre information about the financial standing of the contractor.

Thus, to obtain contracts, the first consideration for a contractor is to set his house in order. He must have financial standing in order to bid, in order to get the contract after bidding, in order to make bond, and in order to purchase plant from manufacturers, especially in lease sale agreements. The making of a financial statement does not mean the actual putting of capital into his business, but it does require the furnishing of accurate and detailed information to insure confidence. Thus, indirectly it increases his capital, for by it he may obtain contracts, valuable assets in themselves, and also credit to purchase machines and supplies far beyond what actual capital would supply. It establishes more firmly his position in the business world.

*From "Successful Methods."

The John ver Mehr Engineering Co., Ltd., has moved from 154 Simcoe St. to 32 Church St., Toronto.

Declaring that high officials of the American Federation of Labor are responsible for "tendencies that threaten the foundations of the government of the United States," a union of draftsmen employed in the U.S. Treasury Department withdrew last week from the American Federation of Labor. The movement is part of a general campaign to secure withdrawal by all government employees' unions.

The Milwaukee Chapter of the American Association of Engineers has submitted a schedule of salaries for the various engineer employees of the city to the city council. The council did not take definite action on October 21st, when the request was presented, but will do so inside of a week or two. The following positions are the principal ones affected by the proposed increases:—Chief engineer of sewers, office engineer of water department, field engineer of water department, chief draftsman, division engineer of street construction, and chief estimating engineer.

AIR LIFT PUMPING*

By Chas. J. Deem
Hydro-Pneumatic Engineer, Harris Air Pump Co., Chicago

IF I had been called upon to write this paper some 12 or 15 years ago, I could have conscientiously and honestly told you many things that I then believed, which time has proven might not always be the case, in regard to air lifts. In that early day of air lift pumping first entering into the commercial field, there were a great many conditions surrounding its operation that were unknown to the manufacturers of the lifts themselves.

It has been charged by many, and more especially by engineers, that the manufacturers of air lift pumps wish to surround their product with mystery. I can truly say that this is not the case. The manufacturers of air lift pumps, like any other trades-people, wish to sell all of their product that they can, and will willingly give all the information regarding its operation that will make it more popular in the deep-well pumping field. However, they are limited in this desire from the fact that no *master formula* has as yet been devised whereby infallible rules may be laid down for the proper designing of any and all installations, without any regard for the conditions that exist in the wells.

The Individuality of Wells

Some 15 years of experience have taught me that in many instances wells are just as individual in their actions as are persons. Therefore, a properly designed air lift installation, operating satisfactorily in one well, might give entirely different results when installed in another well which, to an inexperienced operator, might seem to be identical.

While experience is not absolutely essential to the pumping of water from deep wells by the means of compressed air, yet I know of no engineering field where experience counts for more or is more essential than in air lift pumping.

Some of our best engineers have branded air lift pumping as a system sadly lacking in economy, but in such cases their judgment has been based upon results obtained from improper methods of piping, in connection with inefficient air compressors. Many have also become convinced that there is no special merit in the patented air lift pumps, that home-made devices will answer the purpose just as well. However, in all my years of experience, I have never yet seen one of these home-made lifts over which a patented pump would not give excellent returns on the small amount of money invested in it.

Contrary to a popular belief, the compressed air discharged through an air lift pump does not blow the column of water upward after the first discharge. When the static head is lifted from the working head of the well by the first inrush of air, the water is forced out of the pipe in a solid column. After that, the compressed air passing through the pump reduces the specific gravity of the water in the discharge line of the pump. This consequently moves upward by the expansion of the air bubbles, aided by the greater weight of the solid column of water surrounding the discharge line.

Should Avoid Large Bubbles

In an economically designed air pump, it is imperative that the formation of large bubbles of air be avoided, for these have a tendency to rush upward without lifting the proper amount of water for the stored energy that they contain. Therefore, the pump should divide the air into small streams or jets, creating as many small bubbles as possible in order to give the best economy. The slip of these bubbles constitutes the chief loss in the energy of the air lift. It is figured that this varies as the square root of the volume of the bubbles. Therefore, the smaller the bubbles, the more efficient the air lift.

Of course, one of the foremost things to be considered in the installing of a pumping plant is its efficiency. I presume there is no one word in the English language to-day that is used more in manufacturing and engineering circles than the word efficiency. It is a good strong word, but may be figured from so many different bases of calculation that all conditions in connection with the apparatus must be thoroughly understood before the percentage of efficiency that is claimed for it can be valued. The only true way I know to figure the efficiency of a pumping plant is that at the end of the year the column in the ledger headed "operating costs" be added up and the results calculated from its total. In this column we will also find, if we note down the items such as repairs, break-downs and their attendant losses, and read between the lines the worries that were caused thereby, we can also determine just how efficiently the system has or has not caused trouble.

Workable Efficiency Required

In travelling over the country I find that water works superintendents and manufacturers are more and more demanding workable commercial efficiency from their pumping machinery. They realize that by installing some very closely adjusted high-speed apparatus in their wells, they may be able during its short life to pump water very cheaply per thousand gallons, but that in about nine cases out of every ten, such a pump is sure to cause trouble sooner or later, more often sooner; and that the small amount saved per thousand gallons pumped during the course of the pump's successful operation, is far more than offset by repairs, shut-downs and pulling of wells.

To give some idea of the faith that the underwriters of the country have in the reliability of the air lift system, I will, with Mr. Judd's permission, tell his experience with them in reference to his discarding of deep well pumps and the installing of air lift systems in the city wells here in Mason City. The Board of Underwriters in Chicago granted him 30 points on the key rate of insurance for the fire protection the increased yield of the wells would afford the city, and they gave him 130 points because of the reliability of an air lift pumping system. This is something that should be weighed very carefully, for if there is any institution in the wide world that figures from exact statistics, it is the underwriters. They do not guess, they know.

As I said before, no one has yet been able to figure a master formula for the installation of the air lift any more than has some noted doctor been able to write a master prescription that will cure all diseases to which flesh is heir. However, the manufacturers of air lift pumps have at quite a great expense gathered data from laboratory tests and field experience that enable them to construct formulas which cannot be universally applied to all conditions, yet can define and introduce certain rules which enable them to calculate the requirements for a proposition when the exact data are known.

Exact Data Sometimes Lacking

When exact data are lacking, conditions are usually *assumed* and a lift installed. Then, from results obtained, the engineer, by basing his judgment on experience, can proceed to pipe up the well so as to get economical results. To give an illustration of this:—

Some years ago I installed an air lift in a flowing well on a ranch in southwest Texas. The well was 8 ins. in diameter, about 600 ft. deep and flowed about 20 gals. per min. The owner of the ranch had only a small compressor, its maximum capacity being 30 cu. ft. of compressed air per minute. A 6-in. pump was installed 2 ft. in the well, and this 30 ft. of air delivered to it. The head of the well dropped 20 ft. from the surface and the well yielded 530 g.p.m., accurately measured over a knife-edged weir. Of course, this was phenomenal. Never before or since have I seen such a small volume of air deliver so much water from a deep well.

Only the week before last, at Fort Dodge, Iowa, we installed a 6-in. pump in a flowing well located on an island in the Des Moines river. The well was 8 ins. in diameter, 500 ft. deep and flowed 21 gals. per min. The same size pump was located 200 ft. from the surface, and we delivered to it 200 cu. ft. of air. The working head of the well dropped 150 ft. from the surface and yielded 80 g.p.m. This proved

*Paper read before the Iowa Section of the American Water Works Association at Mason City, Iowa.

to be a very uneconomical installation, yet, to all outward appearances, the conditions in the second well were the same as those in the first, and the results almost beyond comparison.

It is in this second well that experience would have been necessary to have properly piped it up had the city decided to use it. However, they had plenty of other water available, so the well was abandoned. But an air lift could have been installed in it in such manner that, figuring from the current input at the motor of the compressor to the water discharged in the reservoir, it would have shown 30% efficiency. This could have been obtained by installing a 3-in. air lift and taking 50% submergence, or, in other words, by placing the lift as far below the working head of the well as we were going to lift the water. This would have yielded one gallon of water for 0.63 of a cubic foot of air at 67 lbs. pressure.

Misleading Results

Of course, the starting pressure in this well would have been greater than that of the other wells of the system, yet this could have been offset by the use of an auxiliary air line to lift the head of the well. Had the original installation in this well been let stand, anyone wishing to speak disparagingly of air lift pumping could have in all honesty cited it as an expensive mode of pumping water. On the other hand, some manufacturer wishing to extol the virtues of his pumps, might have honestly printed a glowing advertisement of the results obtained in the well first described. Both would be equally misleading. The first is a result from what might be termed a freak well, while the installation of a 6-in. pump in the second well would be improper for the best results obtainable by the air lift system. I only cite these two wells to illustrate my point that each well forms an individual problem and that the same installation in all wells would fail to pump them properly just as would the same medicine fail to cure all men suffering from disease.

One reason why the air lift pump proves valuable in many parts of the state of Iowa, or for that matter in any other part of the country where the water contains as much iron and sulphur as it does in this locality: When a well is pumped by air, the water undergoes a complete aeration, for the air and water are mixed under pressure and this tends to throw off the sulphur gas and precipitates a great deal of the iron. One of the principles on which the iron-breaker works is aeration.

Also, many of the wells in this part of the state pump a great deal of sand, and as the air lift has no moving parts in the well, grit has no effect upon it. Any number of wells may be pumped from a central plant and there is no limit to the quantity of water that can be handled, and with a properly designed system, the extra cost of pumping wells located a mile from the power plant is not material. It has been stated that an air lift system requires little or no attention aside from keeping the compressor in proper running order. While this is practically true, and cited as one of its many advantages, yet sometimes it works to a disadvantage, because it will continue yielding water for years without giving any trouble, yet there are times when the system becomes unbalanced and the working heads of the wells recede (which changes the percentage of submergence), thereby reducing the yield of the well and increasing the amount of air required.

If the wells were checked up once or twice a year, and changes made to meet the new conditions, a great deal might be saved in operating cost. Sometimes very little things cause quite a great loss in economy. Not so long ago, I was called to a plant where a battery of five wells was being pumped from one compressor. The compressor at its maximum speed was barely large enough to pump the amount of water required. The operator told me that when the plant was first installed it gave excellent results. But there had been a decided falling off in the yield of the wells. The system was well designed and should have given good results. Upon investigation I found that two of the wells were much weaker than the other three and that they operated at about 15 lbs. less pressure than the other wells. When the engineer had balanced the system, he had set the regulating valve at the well head of these two weaker wells so as to admit only enough air to pump the water that they would economically yield, and, of course, had left the valves wider open on the strong wells.

When starting the system, the operator discovered that many times these two weak wells did not come in. Their static head being the same as the stronger wells, and therefore being supplied with much less air, did not start so easily. In order to overcome this he had very thoughtlessly taken a wrench and opened the valves of these two weaker wells. Any force follows the line of least resistance and the larger part of the volume of air rushed into the weaker wells, where it could not lift the amount of water that it could have done in the stronger wells. Therefore the system was out of balance and giving poor results, through no fault of the air lift or the man who installed it. When air lift systems are excessively costly to operate, I think it might safely be concluded that there is a good cause, and that the chances are that the trouble might be easily removed.

A great many mistakes are made when installing air lifts, especially by novices in the business, in reference to the size of the pump to be used to deliver economically a certain volume of water. In order to make that as plain as possible, I will give a concrete example:—

For instance, if we wanted to lift 150 g.p.m. from a well with a working head 80 ft. below the surface, the most economical pump to be installed would be a 3½-in. lift at 65% submergence. Under these conditions this pump should yield one gallon of water for every 0.3 cu. ft. of air at 67 lbs. pressure. As you can easily figure, the pump would be located 229 ft. from the surface. Now, suppose instead of being able to get 65% submergence, we can only get 40% submergence. In order to deliver 150 gals. per minute under these conditions a 4½-in. pump should be used, and one could expect a gallon of water for every 0.59 cu. ft. of air at 25 lbs. pressure.

By a little figuring one can ascertain that it required one and one-tenth more horse-power to raise the water in the second instance than it did in the first, and I gave it, hoping to be able to show that even though conditions be vastly different in various wells, a properly designed air lift can be made to yield good results. But, of course, there are places and conditions under which some other type of pump should be used.

As you can note from this example, as the submergence decreases, the size of the discharge line should increase. But this is only a general rule, and the conditions in the well to be pumped entirely govern the ratio of the change to be made.

Variable Discharge Lines

Of late years some firms have been advocating a variable discharge line. I mean by that, some firms wish to start with a smaller pipe and expand toward the point of discharge, the theory being that by allowing the compressed air more space in which to expand, it will lend more of its energy toward lifting water. On the other hand, some firms advocate turning this type of installation upside down, as it were; that is, they reduce the line toward the point of discharge, the theory being the same as the reason for choking the muzzle of a rifle in order to keep all the gases behind the bullet until it leaves the barrel.

Of the two systems, so far as observation has gone, the latter is to be preferred. I have seen it produce excellent results under some conditions; that is, by getting more water by greater economy than would be possible to get from a uniform discharge line made of our standard pipe sizes. I suspect that the friends of the expanded discharge line system will challenge this statement and point to some installations which they claim to be very successful. I have seen one or two of these, but they have been invariably installed in excellent wells that yielded large quantities of water very economically, not because of the system of expanding the discharge line, but in spite of it. However, improvements are being made in the system of piping, and each year shows more practical results than the preceding one.

Another improvement in the air lift system that I wish to mention briefly is what is known as the booster pump. This pump, or tank, is located on the well top and automatically separates the air and water as it is discharged from the well, retaining just enough pressure from the separated air to force the water to the point of discharge. This is indeed a great improvement when the water must be transferred long horizontal distances toward the point of discharge. This point may be at the surface or at an elevation. Hitherto when horizontal distances had to be considered, unless the water was delivered to an elevated tank and allowed to flow by gravity, the air would get ahead of the water in the discharge line, thereby materially reducing the efficiency of the system. However, the booster very efficiently overcomes this condition.

I have given no tangible data on the air lift, but from the varying conditions that exist in all wells, any statements regarding the air lift system as a whole must be of a general nature. Some manufacturers have, at no little trouble and expense, conducted exhaustive systematic tests in natural wells, or in artificial wells constructed for the purpose of maintaining any desired submergence by feeding water into them. The data that they thus gained is authentic for the conditions under which it was gathered. However, in the field nature does not make a habit of supplying her wells with water by pouring it in at the top. So we revert to the same premise from which we started. That is, each well presents a separate problem.

Another thing that has materially aided in the efficiency of the air lift system is the perfecting of air compressors by the various manufacturers. The standard compressors now offered on the market in nearly every instance operate on from one-third to one-fourth the horse-power that was required by the machines built some ten or twelve years ago. Not only is the economy of these machines much greater, but also the mechanical parts have been greatly simplified, thus bringing the air compressor into the realm of most economical machines.

U.S. ENGINEERING COUNCIL'S COMMITTEE ON CURRICULA OPPOSES PRESENT ADOPTION OF SIX-YEAR ENGINEERING COURSES

UNDER date of August 21st, 1919, the secretary of the American Institute of Electrical Engineers referred to the U.S. Engineering Council a portion of a report presented at a meeting of the Development Committee of that institute. The portion of the report so referred to the Engineering Council read as follows:—

"There is a universal recognition of the fact that engineers do not participate as actively or as prominently in public affairs as they should, and that both the public welfare and their own individual advancement would be promoted if this condition could be rectified. There are two general reasons believed to be responsible for the existing condition: One, a lack of any general organization of engineers which would facilitate their co-operation; and second, too great technical specialization in the engineering curricula of our technical schools and colleges, which tends to narrow the vision of the engineering student and start him on his career with an exaggerated idea of the importance of specialization and an insufficient appreciation of the part he must play in public affairs. The second reason, namely, a possible modification of the engineering curricula of our technical schools and colleges, while perhaps of underlying and fundamental importance, was nearly crowded off the Lake Placid program by the press of other matters. It was, however, the unanimous view of the members attending the sessions that this matter should receive early and thorough consideration by the institute, and the following preamble and resolution were presented and adopted:—

"'As the individual engineer cannot look for greater public recognition or individual advancement than his training and fitness warrant;

"'And, in the belief that the bigger development of the profession consists in broader social and public service by publicly minded engineers;

"'Recognizing that on the one hand young engineers are employed for too long a period at work which does not stress their capabilities, and, on the other, that the demands of industry for ever-increasing numbers of technicians must be supplied;

"'And having in mind the excellent precedents established by the medical and legal professions;

"'This committee would welcome the establishment at the earliest date practicable of a normal six-year collegiate course in engineering, two years of which at the least should be devoted to training in the humane arts and sciences, including, for example, political science, economics, history and general letters, the last four years being devoted to sound training in the sciences and in only the fundamentals of diversified engineering.

"'With or prior to such a development we would endorse a program for the marked extension of vocational training in the industrial centres in order that the needs of industry may be met.

"'To the accomplishment of these ends this committee requests the appointment of representatives to serve on a Joint Committee of Engineering Organizations to promote such a national educational program as shall provide for the future necessities of the engineering profession consistent with the needs of society.'"

This report was referred by Engineering Council to its Committee on Curricula of Engineering Schools. At a meeting of that committee held October 15th, the recommendations of the Development Committee of the American Institute of Electrical Engineers were considered, and the following report was sent to Secretary Flinn of Engineering Council:—

"While your committee is not prepared to recommend a six-year course for the colleges of engineering, your committee calls particular attention to the fact that a six-year course was inaugurated at Columbia University some few years ago, practically on the same plan as in the case of the schools of law and medicine, the technical studies of the engineering portion of the course being concentrated on the last three years and based upon three years devoted to studies leading to the B.A. degree.

"The Massachusetts Institute of Technology is also conducting a six-year course in engineering, this being in addition to, and without interference with, the regular four-year course. A somewhat similar program, although perhaps less formal, is followed by the majority of the students in the Harvard University Engineering School, who first take their bachelor's degree in Harvard College, followed by two years in the engineering school. This problem is also being studied and experimented on by other universities.

"Your committee suggests that, as these practical experiments with the six-year course will furnish information not now available, any final recommendation can well be deferred until the results of these experiments can be studied and appraised.

"Your committee is now prepared to report unfavorably on the proposition to substitute the six-year course in place of the four-year course generally in the colleges.

"Your committee strongly endorses the proposition to extend and enlarge the facilities for vocational training, particularly in the great industrial centres; this educational work, however, to be carried on without interfering with the courses in engineering.

"Your committee also favors universal military training under proper regulations.

"Your committee does not agree that military training and vocational training should be combined, except so far as the vocational training would be found to be naturally involved in the military training."

AN EXPERIENCE WITH A BROKEN 24-IN. WATER MAIN*

By S. L. Etnyre
Superintendent, Council Bluffs (Iowa) City Water Works

MOST water works men, no doubt, have had more or less experience in the breaking of water mains, and yet I am sure they are ever interested in finding out what the other fellow's experience has been; to know what effect such a break had upon the service; damage done by the water; cause of the break; etc. Before entering upon our recent experience with the blowing up of a 24-in. main, I will briefly describe its history and its importance in the operation of the plant:—

This main was laid on Broadway, in the year 1882, running from the Broadway Pumping Station at 37th St. to 21st St., a distance of 8,500 ft. From this point to 8th St. is 5,323 ft. of 20-in.; thence to the high-level storage reservoirs, 5,200 ft. of 16-in. Up to 1915 all the water for the city was supplied through this 24-in. pipe. On account of the importance of this main, and owing to the fact that with increased consumption the pressure materially increased, it was found necessary to lay an auxiliary 16-in. main from the Broadway Station to 21st St., and this was completed in 1915. With the reservoirs' storage, it was calculated that the 16-in. would supply the city in the case of any mishap to the 24-in. Two 24-in. valves were cut in the Broadway main and a drain laid into the sewer from the main at its lowest point.

Four Breaks in Thirty-Five Years

In 1884 the Broadway main broke at 30th St., a section 12 by 24 ins. blowing out at the bottom. No flaws were noticeable. In 1908 this main broke at 28th St. A triangular section 18 ins. at the base and 6 ft. long blew out at the side. No flaws were noticeable. In 1909, on the west side of 34th St., the pipe broke as if pulled apart. No flaws were noticeable.

The normal pressure carried by this pipe was 105 lbs. Our last break took place October 6th, 1919, on the east side of 34th St., a 12-ft. section splitting on its side for its entire length. The pressure dropped suddenly from 125 lbs. to 17 lbs. The volume of water escaping through this break was enormous, resulting in the drop of pressure all over the city, and many parts—even at moderate elevations—were without water until the valves were closed. From measurements taken at the high-level reservoir, making allowance for the normal city consumption, over 1,000,000 gallons had run out through this break. Fortunately, however, there was no material damage to private property.

The pressure chart at the pumping station plainly showed the time of closing the valves. Some time was lost in this work by the breaking of a 24-in. valve stem. Pumping to the city through the 16-in. main was started immediately upon the closing of the valves. The drain valves into the sewer were then opened, and when the pipe was broken into, it was found to be entirely free of water. It is also remarkable that all valves proved to be water-tight. The defective section was broken up with sledges and replaced with a new length, and the main was ready for service within 15 hours from the closing of the valves. During the time the repairs were being made, less than 1% of the consumers of the city were without water, and but for the breaking of the valve stem above referred to, less than one-half of the 1% would have been without water.

Original Casting Well Preserved

Pieces of the broken pipe show that the original casting is well preserved, although a casting defect is indicated at one point. A careful examination of the fracture, however, does not warrant the assumption that this condition prevailed to any extent. The thickness of the shell along this line of fracture was a good average with the rest of the pipe, being approximately 1 in. The question that now naturally suggests itself is, "What was the reason for this break?" Of course, the water pressure was partly responsible, but that is not the complete answer. We know by looking at the pressure chart that it was not caused by "water hammer." The thickness of the shell seems adequate for the pressure it had to carry; it was a good grade of metal and no evidences of serious flaws on fracture line or elsewhere were found when broken into small pieces.

*Paper read before the Iowa Section of the American Water Works Association.

UNIQUE MEMBERSHIP CAMPAIGN LAUNCHED BY AMERICAN ASSOCIATION OF ENGINEERS

WITH arrangements made for the largest sales organization that ever sold an engineering commodity, the American Association of Engineers announces a membership drive during the first two weeks of December. A letter from the secretary of the association says:—"There will be 9,000 salesmen, 90 branch sales offices, and 4 district sales offices. That summarizes the sales organization of A.A.E. If every salesman makes a sale, that is 9,000 sales; if every branch office turns in 100 applications, that will be 9,000 more.

"The method to be employed is similar to that used in obtaining subscriptions to the Liberty loans.

"The 90 clubs and chapters will divide their members into membership teams, each with certain territory to cover, and under the supervision of a team captain. The drive will be handled for each chapter by a drive commander who will keep in direct touch with the national headquarters of the association by telegraph. He will make telegraph reports of the number of applications obtained each day. A force will be maintained at the national headquarters to tabulate the returns and to advise the chapters of their standings.

"For the purpose of competition, chapters and clubs will be divided into two groups: Those having more than 100 members at midnight on December 13th, when the drive ends, and those having less than 100 members on that date. A special gavel will be presented to the chapter or club in the latter group which has the greatest percentage of increase of membership during the drive. Of the chapters having 100 or more members at the end of the drive, official A.A.E. colors will be presented to the one that has obtained the greatest percentage membership increase during the drive.

"The three members securing the greatest number of applications between the first and thirteenth of December, inclusive, will be awarded respectively a life membership in A.A.E., a collection of books to the value of $100, and a watch of the value of $50. The captain of the membership team in each chapter or club which obtains the greatest number of applications of all the teams in that chapter or club, will be awarded a solid gold, engraved, A.A.E. watch fob. Individual chapters and clubs may award special prizes to their members. The referee in the drive is Isham Randolph, consulting engineer of Chicago.

"With a membership of almost 8,500 at the end of October, it is probable that the American Association of Engineers will easily pass this year the 10,000 membership mark which was set last spring as a goal for 1919."

The Franklin Institute, acting through its Committee on Science and the Arts, has awarded its Edward Longstreth "Medal of Merit" to John Walter Ledoux, of Swarthmore, Pa., for the Simplex Venturi Meter, manufactured by the Simplex Valve and Meter Co., Philadelphia, Pa.

The Wallace & Tiernan Co., Inc., 349 Broadway, New York City, manufacturers of chlorinating apparatus for sterilization of water supplies and sewage, have recently made a change in their representative on the Pacific Coast. Their interests will hereafter be taken care of by Alexander Bell, with office at 709 Mechanics Institute Building, San Francisco, Cal. Mr. Bell will handle all installations on the Pacific Coast and will keep emergency outfits in stock.

H. W. Nelson's Plan of Payment for Estimating

Rules and Procedure Whereby Each Project is Considered Separately—Fundamentals to be Observed in Estimating—Statement Submitted by Mr. Nelson to Committee on Methods of the Associated General Contractors of America

ESTIMATING costs and establishing prices is an overhead expense involved in any merchandising, but the cost of doing so is generally nominal, if not insignificant, and can be justifiably distributed. The cost of figuring or estimating work to be peformed in accordance with special specifications to meet each case, however, differs materially from establishing a price on each of a thousand hats, all made from the same material and from the same pattern. The Nelson Form for Choosing Bidders and Awarding Contracts has, therefore, been suggested to meet special conditions; to more justly distribute the cost of competition and estimating, and to make each project bear its own proportion of the cost.

It is submitted with the thought that there are three main factors entering into the relations between the purchaser and the seller, viz.:—

1. Quantity and Quality of Materials.
2. Character of Labor and Personal Service.
3. Price to be Paid for Both.

The first factor can be determined and somewhat definitely set forth in the form of plans and specifications to be furnished by the purchaser to the seller, upon which the seller can base his price.

The character of the labor and personal service rendered by the seller or expected by the buyer varies as much as human nature varies, and cannot be so definitely or exactly set forth.

The price, or third factor, can be based definitely upon the materials, but must necessarily vary upon the Personal Service, depending upon the value placed upon it by either the seller or the buyer; therefore—

The purchaser should be allowed to exercise his recognized personal liberty in choosing the party with whom he wishes to enter into a contract, basing his choice upon price, his own confidence in the seller, his own judgment of the seller's qualifications or experience necessary to render the service he wants, or any other factor that he may himself consider most important.

And when the purchaser desires competition to enable him to make comparisons or decisions based upon a combination of all three factors, competition which involves labor and expense on the part of the seller, then the purchaser shall purchase that competition at a fair and just price, just as he purchases anything else.

Fundamentals in Awarding Contracts

Under the Nelson form of choosing bidders and awarding contracts, it is the intent:—

First—That the buyer may have just as much fair competition as he wishes to pay a reasonable and fair price for; that he, alone, desires the benefit of competition, and that no one buyer should pay for competition received by another —an abuse that exists under present methods.

Second—That when and after the buyer has chosen his competition in a fair, unprejudiced manner, and has further paid a just and reasonable price for said competition, he shall be under no moral or other obligation to the bidders; that he may make his own decision, based upon his own opinion of the qualifications of the bidder or the bidder's price, or a comparison of both.

Third—That the buyer may, as he chooses, select a limited or large number of bidders. If the work is of a private nature, he may wish to choose a very limited number, if he wants competition at all. If the work is of a public character, he may necessarily wish to give every qualified public citizen bidder an opportunity to compete, but without the necessity of paying more for the competition than he may consider the competition is worth.

Fourth—If the work be of a public nature, the buyer may have good reasons for first selecting a limited number of bidders because of their residence near the work to be done, or because they may be familiar with or may have had previous experience with the work, or for sundry justifiable reasons.

Fifth—That when the buyer, in case of public work, has then chosen his preferred bidders, he may give every other public citizen who is qualified to bid an opportunity to compete by chance or lot for consideration as a bidder, limiting the number to be chosen in accordance with the value of the competition to him.

Sixth—That the bidder shall in no way be considered as an engineer, but solely in the light of a bidder and contractor capable of doing work in accordance with complete plans and specifications; and that, therefore, in every case where bidders are expected to bid in competition, they (the bidders) shall be furnished by the buyer with plans, specifications, drawings and instructions covering the work to be performed as completely and specifically as commercially possible, with sufficient details to enable a bidder to fully understand what he is expected to figure and bid upon.

Seventh—That if a buyer cannot or will not provide complete detailed plans and specifications for the work, but wants estimates, measurements, figures or advice of a professional nature, then he (the buyer) shall consider such work in the light of a professional service, and it shall not be considered proper, fair or just to ask for competitive price bids, but that the charges for such professional service shall be left solely and strictly for adjustment between the buyer and seller, either before or after the work is done. Approximate estimates shall not be considered binding upon either party involved.

Reducing the "Gamble" to a Minimum

That under no circumstances shall the amount of a competitive bid be altered or the intent of the bid be changed so as to equivalently alter the amount after the bid has been submitted and before the contract has been let.

That no reductions or additions shall be made in bids for the purpose of meeting lower bids or because of proposed changes in plans and specifications. That under such proposals by the buyer, either new bids, based upon new plans and specifications, shall be asked and paid for—or—the contract shall be let and mutually satisfactory arrangements then made between the buyer and seller. That what is now known as "shopping" or "peddling" bids shall be discountenanced by both buyer and seller.

Such a system would place the expense of estimating where it belongs, i.e., as an expense against the job for which it is incurred. It would place the owner or architect under obligation to no one. He could, with fairness to all, let the contract to whomever he chose. The contractor could thus eliminate much more of the "gamble" in bidding, which would, in turn, benefit the material dealer and manufacturer, the bonding companies, and the bankers. The fact that owners and architects could choose their contractors as they saw fit without obligating themselves to choose the lowest bidder should not operate to increase graft or unfair discrimination. Crooked building committees or architects are the exception and very far from the rule, and there would not be any occasion for private owners to select contractors except on merit. Let the best man win, everything considered, not price only. At any rate, the possibilities for graft under such a system are not as great a menace to contracts as the evils of present-day competition and wasteful estimating.

Quantity Survey and the Nelson Form

The "Nelson Form of Choosing Bidders and Awarding Contracts" should not be construed as conflicting with the "Quantity System" or "Unit Systems." The Nelson Form

should be equally as just and fair if used in connection with the "Quantity System" as without.

The only way in which the "Quantity System" could affect the Nelson Form would be to reduce the bidder's compensation, because some of his work and service would be absorbed by the "Surveyor," and, of course, if the quantities are guaranteed by the surveyor, it would more materially reduce the bidder's compensation, if not eliminate it.

Many of the best, most successful and responsible contractors are opposed to "Quantity Systems" and "Unit Systems" for the reason that their universal and complete use would place the sale of building material in the hands of manufacturers and jobbers, and take it out of the contractor's hands altogether; and, therefore, the contractor under such

EXHIBIT A

Average of all bids or estimated net cost of contract	Approximate square root of figure in column one	Number of bidders to be selected† Figure in column two multiplied by .04	*Amount to be paid each bidder Figure in column two multiplied by .7	Total cost of competition Figure in column three multiplied by figure in column four
$ 50,000.00	224	9	$156.80	$1,411.20
60,000.00	245	10	171.50	1,715.00
70,000.00	265	11	185.50	2,040.50
80,000.00	283	11	198.10	2,179.10
90,000.00	300	12	210.00	2,520.00
100,000.00	316	13	221.20	2,875.60

Explanation

†Not less than two. As many more bidders may be selected as the buyer wishes to compensate.

To determine the total number of bidders, estimate the amount of the contract in dollars sufficiently high (Clause 3, Public Work); compute the square root and multiply by .04.

To determine the amount to be paid each bidder, add all bids (including any and all alternate figures asked for and received), divide the sum by the number of bids to get the average, then take the square root and multiply by .7. In case of fractions, the next highest whole unit number shall be used. Carefully read Clause 11, "Paying for the Competition."

*The multiplication factor .7 is not set or established. It is the intention of this form that this factor should be determined or established by the seller individually or collectively in the same manner in which he sets the price upon any merchandise or service.

Where it is necessary for the bidder to incur travelling or other incidental expenses it is the intent of this form that he shall receive remuneration for same in addition to regular compensation provided for in Exhibit A. The bidder shall, however, make arrangements with buyer for such special compensation, and have same accepted before bidding.

conditions would be reduced to a contractor of labor only, if, indeed, he could exist at all. And when it is understood that the handling of labor is generally fraught with more trouble and less profit than anything else in the contracting business, it can be readily understood that many of the good contractors say, that when that time comes, they will use their investments and ability in some other business.

Many architects are opposed to the "Quantity System" in this country at this time, because they think its use would delay the preparation of plans and specifications. They say that the American builder is inclined to wait until the very last minute before deciding to build; that he will plan and figure upon erecting his building for two years, then go to the architect and expect to move into it the next week.

The architect rarely has half enough time to do his work and do it as well as he wants to.

They say that if a quantity survey were to be made of each set of building plans and specifications, it must be nearly correct in every detail, and that the quantity estimator would require as much time as the architect to do his work right, and that altogether the time consumed between getting the commission for the architectural work and letting contracts would be two or three times as much time as the architect can get from his client.

And again it is contended that "Quantity Estimating" is essentially a new profession, and that it will be necessary to train men especially for that work; that while it may be possible to have the work done in the next few years in metropolitan cities, it will be many years before it can be accomplished in more sparsely populated centres.

The writer feels that from an ideal standpoint, "Quantity Survey" is something to be looked forward to with earnest eagerness, and is progressive enough to feel that there is great hope.

However, it will take time to bring it into practice, and when we have educated the public to appreciate that in the majority of times they get just what they pay for, and when we have converted the impulsive, impetuous, careless, "plan-nothing-ahead" present-day American builder into a safe, conservative, "plan-everything-ahead" builder, then we will have the more efficient, safe and sane method—"quantity system," and the quantity estimator will be here. Then, perhaps, the present-day American contracting gambler's successor will be the conservative quantity engineer. And that is all the subject really amounts to. Reduce the gamble and do more engineering. For "quantity estimating" is a professional engineering service.

In the meantime, during this generation, why not do everything we can to protect ourselves and the deserving present-day contractor from the unscrupulous ones by adopting a just method of competing which will not interfere with a higher and better class of engineering, such as the "quantity system" will give.

The Contractor Who Bids for Nothing

I am also frequently asked the question, "How are you going to prevent contractors from evading the practice if it is established?" By educating the contractor to better business methods, and by educating the architects and owners for their own good to refuse to consider contractors whose business methods are not correct. Those who can't be educated can do no good anyway. How could you prevent a man from giving his clothes away if he were foolish enough to do it? But when consumers and their representatives learn that they are really paying less for competition and getting a better class of competition one way than another, they will soon adopt the former. It was a long time before the "one-price-to-all" idea was adopted in selling merchandise. It came all at once and is now in almost universal use. Some merchants still dicker, but the better ones do not. Some contractors may bid without charging, but the better ones will not when they understand the advantages of this plan to them. Some contractors would also like to see their competitors charge for bidding so that they themselves can offer to bid and figure free of charge. But such men harm themselves mostly. At least, they or their practices are not the ones we should follow.

I believe the only solution of the problem is to have a national association of some kind, which is not organized for personal profit, take hold of it. They could inaugurate a system whereby the local organizations could, through their secretaries, put the system in force and collect compensation. The national organization in this way could collect from each local organization a small percentage of the compensation, and, I believe, thereby build up a very strong national organization financially, and in that way could keep the contractors together.

THE NELSON FORM

Rules and Methods of Procedure

PUBLIC WORK

1. Procuring Applicants to Bid Upon Public Work

If the work is of a public character, it is conceded that every public citizen who is qualified to bid shall be given consideration. Therefore, the buyer shall advertise in all recognized local newspapers simultaneously for a fifteen-day

period of time at least, setting forth that he intends to let a contract, requesting all those who wish to submit bids to file an application. Such advertisements shall clearly state the character of the work and its location. The application from bidder shall be in the hands of the buyer upon a certain date, and not less than fifteen days from the date the first advertisement appears. Immediately upon receipt of the application, the applicant shall be given a receipt therefor.

2. Approving the Applications from Bidders

Known incompetency, lack of experience in the class of work contemplated, insufficient organization, or insufficient capital or equivalent to carry out the contract, or unsatisfactory previous experience with applicant, shall all be considered good, just and sufficient reasons for non-consideration by the buyer and his refusal to approve the application. All other applications shall be approved and given consideration. It shall, however, be considered obligatory upon the buyer to immediately and fully state his reasons for failure to approve an applicant if called upon to do so.

3. The Number of Bidders to be Selected

The minimum total number of bidders to be selected shall be determined by taking the square root of the estimated net cost of the proposed contract in dollars and multiplying by .04 as shown (Exhibit A), or thus: If it is estimated that the contract cost will be $10,000, the square root of which is 100, multiply by .04, which gives 4 as the minimum number of bidders to be selected. In case of fractions, the number nearest the next highest whole unit shall be selected. It is obvious from the intent of this form that the buyer may have as many additional bids as he may want, provided he wishes to pay for the cost of such additional competition, and with the further provision that he fairly choose such additional bidders, as provided for in Clauses 4 and 5. Should it be found that the buyer, in case of public work, intentionally or unintentionally, has estimated the contract more than 10% lower than the lowest bid, it shall be considered good and just cause for complaint on the part of the uninvited public citizen bidders, on the grounds that the buyer has kept his estimate low so as to exclude bidders or reduce the number of bidders considered legitimate for public work under this form.

4. Preferred Bidders Selected by Buyer

The buyer may, at his discretion, or if he chooses for good and sufficient reasons to do so, select and invite one or more preferred bidders, but the number of such preferred bidders shall in no case exceed a number equal to one-half of the total number of all bidders selected. It shall, however, be obligatory in case of public work upon the buyer to immediately divulge or make public the names of such selected bidders, if requested to do so, and to give his reasons for selecting them.

Because a certain contractor is selected as a preferred bidder it shall not indicate that he is to be or shall be given preference in awarding the contract, but rather that the privilege given the buyer to select a limited number of bidders is more for the purpose of enabling him to obtain low but meritorious bids.

5. Bidders Chosen by Lot

The remaining number of bidders to be invited after the preferred ones have been chosen (Clause 4) shall be chosen by drawing lots thus: The names of all applicants (except those who may have been selected as per Clause 4) who have made written request upon regular form and have been approved by buyer as per Clause 2, shall be placed on stiff blank cardboards not smaller in size than one inch wide by three inches long. These cardboards, with the names of the applicants clearly written or printed upon them, shall be placed in any convenient opaque receptacle not less than five inches deep, closed on all sides and bottom, but open at the top. Then a totally disinterested or blindfolded party shall draw from said receptacle a number of cards, no more nor less than the number of bidders to be chosen by lot. The names of the applicants appearing upon the cards drawn shall be duly selected as bidders. This drawing shall be at all times open to the public or interested applicants.

6. Notifying Bidders and Bidders' Agreement

When the required total number of bidders have been chosen, all applicants shall be notified. The applicants who have been selected to bid shall then be given all necessary plans, specifications, drawings and instructions. They shall also be given a "Bidders' Agreement," which, after acknowledging receipt of plans, etc., binds the bidder to abide and conform to all rules and regulations set forth in "The Nelson Form for Choosing Bidders and Awarding Contracts," and the buyer to pay for the estimate the amount stipulated in the above-mentioned "Nelson Form," based upon the average of all bids within the stipulated time after letting contract.

These plans and the "Bidders' Agreement" may be handed to bidders in person or sent to them by United States registered mail, and no contracts shall be let or bids opened except as provided for under Clause 8 and Clause 9, until all invited applicants or their substitutes, as provided for under Clause 7, shall have returned signed "Bidders' Agreement."

7. Failure to Submit "Bidders' Agreement"

Should one or more bidders fail to return the "Bidders' Agreement" within fifteen days of registered mailing date of the notification, then the buyer may, if he so desires, choose other bidders to substitute for them under the same method described under Clauses 4 and 5, as the case may be, by or under the form by which the defaulting bidders were selected, and an extension of the time set for opening bids may be made.

8. Defaulting Bidders and Failure to Submit Bids

Failure on the part of one or more bidders (after they have submitted signed "Bidders' Agreement") to submit their bids in due time or in correct form shall not in any way obligate the buyer to defer or delay the awarding of the contract.

9. Failure to Secure Stipulated Number of Applications

Should the total number of applications from bidders after advertising the stipulated time not reach the number provided for in Clause 3 or Exhibit A, then the buyer shall reserve the right to open bids and let the contract with the number of bidders that have made application, without in any way violating any of the rules, terms, agreements or intentions of this form.

10. Awarding the Contract

If the buyer or buyers be acting in the capacity of public servants, or in behalf of organizations, they shall, in accordance with the intent and meaning of this form, award the contract on the basis only of serving the best interests of the public or their constituents, as the case may be. No personal prejudices shall be shown or personal preference given, but the award shall be based solely and only upon the basis of procuring the best material and service at the lowest cost. All bidders, however, to receive full compensation for estimating and furnishing competition, in accordance with Clause 11.

11. Paying for the Competition

After all bids have been received and opened, the buyer shall within ten days (whether or not contract has been awarded) pay to each and all bidders (who have bid in strict accordance and complied with all of the demands contained in the plans and specifications and all forms accompanying same, and whose bids do not exceed by more than 25% per cent. the amount of the bid upon which the contract is awarded, or the lowest legitimate bid if contract is not awarded) a sum equal to the square root of the average of all bids received multiplied by .7 substantially as shown in table (Exhibit A), thus: If the average of all bids received shall be $90,000, the square root of which is $300, multiply $300 by .7, which equals $210, the amount which shall be paid

to each competing bidder in payment for the labor and expense involved in estimating and as a complete waiver of all obligations. In considering the amount of each bid, the total bid, including the sums of all alternate estimates asked for by the buyer, whether they be additions or subtractions, shall be considered, and the amount to be paid the bidder shall be reckoned thereon as well as upon the total bid; as, for example, if the bidder is requested to estimate upon a brick building with alternate estimate upon stone and another alternate estimate upon frame construction, then, assuming that the bidder's figure is $20,000 upon the brick building, $30,000 upon the stone, and $15,000 upon the frame building, then the sum-total, or $65,000, shall be used in determining the sum to be paid the bidder. Should certain bidders refuse or neglect to figure or bid upon alternates, they shall be paid upon the basis of their actual bids only.

A certificate of payment shall, upon request, be given to each bidder, properly filled in, signed and sworn to by the buyer before a qualified notary public, setting forth that the competition has been conducted in accordance with this form, and that the amount credited or paid to the bidder has been reckoned and computed in strict accordance with this, the "Nelson Form of Choosing Bidders and Awarding Contracts," its true intent and meaning.

PRIVATE WORK

1. Selecting Bidders for Private Work

If the buyer of the work to be figured upon is acting as a private individual, then he may choose his own method for selecting bidders, and he may select as many or as few as he may choose or wishes to compensate.

2. Awarding the Contract

If the buyer be a private owner, he, his architect, his engineer or other form of representative shall reserve the right to make contract with any bidder he may choose, provided, however, that he shall fully compensate all invited bidders in accordance with Clause 3.

3. Paying for the Competition

Paying for the competition in connection with work of a private character shall be done exactly as provided for in connection with public work and as shown and set forth under Clause 11, Public Work.

The Sub-Contractor and the Material Man

In putting this plan into actual operation, the Quad City Builders' Exchange, including the Master Builders of Davenport, Iowa, Rock Island, Moline, and East Moline, Illinois, adopted the following regulations applying to subcontractors and material men:—

. . . . . .

Second.—That this body shall recommend the following minimum factors as a basis for compensating bidders in accordance with the Nelson Form:—

General Building Contractors.—.5 or 50% of the square root of the average of all bids.

Sub-Contractors and other Principal Contractors.—.2 or 20% of the square root of the average of all bids.

Third.—That the above factors shall be used when bids are given to owners, their representatives, or to other contractors when such other contractors are not in competition.

Fourth.—When one contractor, however, renders a bid to another contractor who is in competition, it is arbitrarily assumed that the contractor giving the bid will, on the average, give four bids on the same work which he will have to figure or estimate only once. Therefore, under such subbidding conditions (and only under such conditions), the compensation shall be one-fourth of the regular compensation, or as follows:—

General Building Contractors.—.125 or 12½% of the square root of the average of all bids.

Sub-Contractors. and other Principal Contractors.—.05 or 5% of the square root of the average of all bids.

Fifth.—Building material manufacturers or distributors shall not receive compensation for making unit prices on material. For example, if a price is quoted upon 10,000 brick at $9 per thousand, or 5,000 yards of sand at 60 cents per yard, etc., such bidding shall not deserve compensation; but if such bidder is expected to estimate the material required to do the work intended and then guarantee the quantities or capacities to be sufficient, then he shall be considered in the light of a contractor and receive compensation.

Sixth.—That when the owner, or his representative, furnishes the bidder with guaranteed "quantity surveys"—or, in other words, with a unit of material upon which the bidder needs only insert unit prices and is relieved of the necessity of guaranteeing the quantities to be correct—then the amount of such unit list or quantity survey shall be deducted from the amount upon which the bidder is compensated.

BRITISH COLUMBIA TECHNICAL ASSOCIATION

THE British Columbia Technical Association held its first banquet on October 21st, in the University Club, Vancouver. The gathering took the place of the regular monthly meeting of the association at which it has been customary to deal with purely business matters. The executive intend hereafter to combine every business meeting with a social function. About one hundred civil, electrical, mechanical and mining engineers, chemists and architects were present. The chair was occupied by E. G. Matheson, professor of civil engineering of the University of British Columbia, who gave an interesting address, in the course of which he outlined the great part in the world's work which had fallen to the lot of technically trained men. He reviewed the activities of the association and stated that while the organization is only about eight months old, the membership is about 250, and that a total of 300 is expected by the end of the year. The secretary-treasurer of the association is R. Snodgrass, Board of Trade Building, Vancouver.

EFFECT OF FINENESS OF CEMENT

(Continued from page 438)

15.—Concrete of all mixes and consistencies showed expansion in damp sand or water storage and contraction in air.

16.—The change in length of concrete specimens stored in air or water is independent of the fineness of the cement and the consistency of the concrete. The lean concretes are slightly less affected than the rich mixtures.

17.—The type of aggregate had little or no influence on the relative effect of fineness of cement on the strength of concrete.

18.—The tests included showed an intimate relation between the strength of the concrete and the water-ratio of the mixture. The lower the water-ratio (so long as the concrete is plastic and the aggregate not too coarse), the higher the strength, and vice versa. This confirms the results of other concrete tests made in this laboratory. Increasing the quantity of cement in a given mixture enables us to secure a concrete of equal workability with a lower water-ratio, hence a higher strength.

19.—In ordinary concrete mixtures (say 1:5 to 1:4, requiring 20 to 25% cement, by volume) increasing the cement content by 1% (to 20.2% for a 1:5 mix), gives an increase in strength of about 1%.

20.—One per cent. increase in cement is more effective in increasing the strength of concrete in lean than in rich mixtures.

21.—One per cent. increase in cement is somewhat more effective in increasing the early strength of concrete than at later periods.

22.—The effect of increasing the quantity of cement is independent of the consistency of the concrete.

23.—Tension tests of briquets do not give a correct measure of the relative merits of different cements as determined by compression tests of mortar and concrete.

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WATER PRESSURE UNDER DAMS

IN an article upon another page of this issue, Mr. Maerker calls attention to what he terms a "fallacy in the design of dams subject to upward water pressure." He points out that the overturning moment due to the upward thrust of water near the heel of a dam should not be added to the overturning moment due to the horizontal water pressure unless the upward thrust is greater than foundation reaction. He bases his argument on the fact that the upward thrust due to water simply replaces an equal amount of foundation reaction. He admits, however, that the stability of the dam is impaired by the upward thrust of water, owing to the lowering of the resistance against sliding. Allowance would have to be made, therefore, when designing the structure, for this danger of failure through sliding.

Whether the allowance be regarded as a provision against overturning or against sliding, probably makes but little practical difference. In either case basic assumptions must be taken that may vary greatly in their actual accuracy, and the results might not be such as to warrant the refinement suggested by Mr. Maerker.

Nevertheless it is always interesting to discuss the reasons for assumptions, as it leads to a clearer understanding of the various features of design. Engineering should be based upon scientific laws to as great an extent as possible. It should be empirical only where absolutely necessary through lack of accurate knowledge, or else where advisable in order to save mathematical computations which, if carried out, would yield no adequate return.

While Mr. Maerker's article may not change any of the assumptions used in designing dams and similar structures, it will cause many engineers to give further thought to the subject, which alone will prove beneficial regardless of whether these engineers do or do not find themselves in agreement with the theories advocated by Mr. Maerker.

. The amount of the upward thrust, the area against which it acts, and the line of its distribution, must all be assumed, and in order to be reasonably safe the engineer must make considerable allowance for more than average conditions. The precautions taken by standard engineering practice in the past have no doubt been warranted, and Mr. Maerker would probably insist upon just as much material being used in a dam designed according to the method he suggests, as in a dam designed in accordance with present standard practice.

ENGINEERS FAVOR EMPLOYMENT ACTIVITIES

RESULTS of a referendum recently held by the American Association of Engineers, asking the opinion of the membership as to how the income of the association should be distributed amongst the ten main activities of the association, indicate that of all the things which the members believe to be important, the employment service is the most popular.

The vote proves that the members desire to have about 17% of the income spent on this service. It is interesting to note that compensation was second with about 16%. The official publication, promotional work, publicity, legislation, protection and prevention of abuses, membership, civic welfare, and ethics and practice, were next, in the order named.

Mining engineers voted the greatest percentage to employment, while the least percentage voted to employment was by those engineers employed by educational institutions. Government engineers voted more to be spent on publicity than did any other class of members. The greatest desire for development of the organization appears to lie in the educational group, for those engineers voted 3% more for promotional work than did any other class of engineers.

Public utility employees voted the greatest amount to be spent on legislation, although engineers employed by states ran a close second. Legislation was least desired by government engineers, who voted a full 3% less than those employed by public utilities.

Engineers in private practice voted the greatest amount to be spent on civic welfare work. The least amount voted to this work was about 3%, voted by mining engineers. Engineers in private practice voted a greater amount to be spent on protection and prevention of abuses than did any other class of members.

Municipal engineers voted the most money to be spent on compensation, while railroad engineers, engineers in public utility work, and engineers employed by states, followed in the order named. The complete results of the ballot follow:—

Employment, 17.4%; compensation, 16.3%; association's publication, 14.8%; promotional work, 10.9%; publicity, 9.8%; legislation, 8.8%; protection and prevention of abuses, 8.1%; membership campaign, 5.8%; civic welfare, 4.5%; ethics and practice, 3.6%. The percentage named in every case is the average of the votes cast by the members, and therefore represents the average opinion of the membership as to the percentage of the association's income that should be spent for the various activities.

The result of the vote, as regards employment activities, is no surprise. Just as self-preservation is the first law of nature, the first and basic desire of all engineers—and of everyone else for that matter—is to be ensured of a good market for their abilities. Ethics, membership campaigns, etc., are naturally regarded as of minor importance compared with employment. At the same time, legislation, publicity and other activities have a basic effect upon employment, and in the last analysis may count for more than the direct assistance rendered by a society's employment bureau.

The obligation upon every individual to purchase Victory Loan bonds may not be so apparent as it was during the war, but it is just as real. Depression and unemployment would surely follow the country's failure to absorb the much-needed loan.

PERSONALS

THOMAS R. LOUDON, who was recently relieved of his military duties after having been in the army since November, 1915, has returned to private practice in Toronto and, in partnership with C. S. L. Hertzberg, has formed a new firm, Loudon & Hertzberg, consulting industrial and structural engineers. Mr. Loudon was born September 1st, 1883, in Toronto and was educated in the public schools in that city and at the University of Toronto, where he graduated in 1905, with the B. A.Sc. degree in civil engineering. For one year after graduation Mr. Loudon was engaged in design of gas engines for the McVicker Engine Company, of Galt, Ont. In 1907, he was appointed lecturer in civil engineering at the University of Toronto, and has retained his connection with the university since that date. In 1912, he was appointed assistant professor of applied mechanics, and while he was in the army he was gazetted by the faculty as an associate professor. He has resumed his lectures at the university. Mr. Loudon is the author of "Applied Statics," which he originally wrote as a series of articles for *The Canadian Engineer*, and which has since been used as a text-book by the University of Toronto and other educational institutions. Before the war he was a frequent contributor to *The Canadian Engineer*, and for a time acted as an associate editor of the paper in regard to structural steel and its production. From the beginning of his connection with the university, Mr. Loudon has at all times been in touch with outside work. From 1907 to 1912 he assisted the late T. C. Irving in the inspection of structural steel work for the Standard Inspection Co., of which Mr. Irving was manager, and later for the Robert W. Hunt Co., which absorbed the Standard Inspection Co. and of which Mr. Irving became vice-president. Mr. Loudon also acted as consulting metallurgical engineer for a number of enterprises, chief of which was the Moffatt-Irving Co., Toronto, for whom he acted as consulting and designing engineer, in association with J. W. Moffatt, from 1910 to 1912. This company was organized for the purpose of making experiments in the electrical smelting of iron ore. In 1912 Mr. Loudon became a member of the firm of James, Loudon & Hertzberg, consulting engineers, Toronto, and for the following three years was engaged in various structural and municipal undertakings. In November, 1915, he enlisted as lieutenant in the 2nd Field Company, Canadian Engineers, and was appointed on the staff of Military District No. 2 as an engineering instructor. In May, 1916, he was gazetted captain and adjutant of the 1st Construction Battalion, and went to France with that unit, arriving at the front in October, 1916. He attained his majority on the field before the end of that year, and served as second in command of his battalion until he was invalided home in May, 1918. In 1917 that battalion became the 1st Railway Troops. It was engaged in general engineering construction, chiefly bridges and standard-gauge and light railway work. Major Loudon was mentioned in dispatches for his work at the front. In October, 1918, after he had recovered from his injuries, he was apointed in command of military engineering construction in British Columbia, from which position he was honorably discharged in June of this year.

HADDIN & MILES, LTD., consulting engineers, have moved their head office from Winnipeg to 209 Eighth Ave. W., Calgary, Atla.

MAJ. P. EARNSHAW, of Toronto, has been appointed instructor in civil engineering at the Royal Military College, Kingston, Ont.

F. P. JONES, vice-president and general manager of the Canada Cement Co., Ltd., has resigned from the directorate of the Canadian National Railways owing to pressure of other work.

J. L. ENGLEHART, chairman of the Temiskiming & Northern Ontario Railway Commission, has resigned owing to ill-health. Mr. Englehart has been chairman of the commission since its formation, 14 years ago.

J. C. REILLY, acting general secretary of the Association of Canadian Building and Construction Industries, left Montreal last week for a four weeks' tour of Western Canada. Mr. Reilly will hold organization meetings in Winnipeg, Regina, Calgary and Vancouver. He may also visit Saskatoon and Edmonton.

J. A. ELLIS, Director of Municipal Affairs of Ontario; LAWRENCE VEILLER, secretary of the National Housing Association, New York City; and W. J. DONALD, secretary of the Board of Commerce, Niagara Falls, N.Y., will be among the speakers at the town planning convention to be held November 27th and 28th in Hamilton, Ont.

ENGINEERING INSTITUTE ELECTIONS

AT a meeting of the council of the Engineering Institute of Canada held October 28th, 1919, in Montreal, the following elections and transfers were announced:—

Members.—F. L. Butler, Winnipeg; W. L. Ketchen, Timiskaming; R. L. Peek, St. Catharines; A. H. White, Brooklyn, N.Y.

Associate Members.—A. N. Ball, Regina; F. M. Barnes, St. John, N.B.; H. F. G. Barnjum, Prince Rupert, B.C.; E. H. Beck, Toronto; Sydney Bowen, Morrisburg; L. L. Brown, Vancouver; A. W. L. Butler, St. Catharines; Neil Campbell, Ottawa; E. D. W. Courtice, Chatham; H. R. Cram, Ottawa; F. A. Danks, Toronto; H. W. L. Doane, Halifax; J. G. Dryden, Halifax; R. L. Fairbanks, Port Arthur; K. C. Fellowes, Niagara Falls; A. G. Graham, Vancouver; Byron Hallock, Winnipeg; S. W. Johnston, Niagara Falls; Grover Keith, St. John, N.B.; R. F. Macdonald, Sault Ste. Marie; R. H. Mather, Montreal; H. W. McKiel, Sackville; J. W. McLellan, New Glasgow; D. A. S. Mutch, St. Catharines; W. F. Oldham, Winnipeg; E. R. Pease, Montreal; W. H. Stuart, Hanna, Alta.; H. S. Tawse, Aberdeen, Scotland; W. C. Taylor, Stonewall; A. R. Whitelaw, Campbellford; J. R. Wood, Evesham; E. M. Wynn, Niagara Falls; A. G. Young, Toronto.

Juniors.—E. W. G. Chapman, Halifax; L. H. Cookson, Bathurst; K. L. Dawson, Halifax; W. S. McDonald, Calgary; J. M. Poole, Halifax; E. G. Timbrell, Ottawa.

Transferred, associate members to members.—Charles Brakenridge, Vancouver; P. P. Brown, Vancouver; J. C. Craig, Vancouver; W. A. E. Grim, Vancouver; J. C. Holden, Winnipeg; W. H. Magwood, Cornwall; D. M. Mathieson, Toronto; R. G. Saunders, Toronto.

Transferred, juniors to associate members.—R. S. C. Bothwell, Toronto; Arthur Desrosiers, Detroit; A. D. Kerrisdale, B.C.; J. M. Gordon, Toronto; C. E. Hogarth, St. Catharines; F. C. Knight, Montreal; L. P. Macrae, Victoria; W. P. Murray, Lachine; J. B. O. St. Laurent, Ottawa; R. A. Spencer, Montreal; C. St. J. Wilson, Halifax.

Transferred, students to associate members.—R. M. Calvin, Ottawa; W. E. P. Duncan, Milton; R. R. Hepinstall, New Orleans, La.; A. A. Richardson, Peterborough.

Transferred, students to juniors.—G. F. Alberga, Montreal; J. F. Brett, Montreal; W. McG. Gardner, Montreal; B. A. Johnston, Winnipeg; G. W. F. Johnston, Ottawa; G. F. Layne, Cheshire, England; W. G. Mawhinney, Selkirk; D E. McPherson, Winnipeg.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand or proposed, contracts awarded, changes in staffs, etc.

ADDITIONAL TENDERS PENDING

Not Including Those Reported in This Issue

Further information may be had from the issues of *The Canadian Engineer*, to which reference is made.

PLACE OF WORK	TENDERS CLOSE	ISSUE OF	PAGE
Ottawa, Ont., kitchen equipment for Parliament Buildings	Nov. 8.	Oct. 23.	52
Sorel, Que., repairs to wharf	Nov. 7.	Oct. 30.	54
St. Clements, B.C., bridge	Nov. 19.	Oct. 16.	48
St. Hippolyte, Que., construction of school building	Nov. 8.	Oct. 23.	52
Toronto, Ont., water meters	Nov. 18.	Oct. 30.	45
Winnipeg, Man., supply of remote electric control for two 36-inch gate valves	Nov. 10.	Oct. 30.	45

BRIDGES, ROADS AND STREETS

Belleville, Ont.—City council is considering the construction of a granolithic walk near Grove St., the paving of Murney Hill and a portion of West Bridge St. City engineer, S. G. Mill.

Boston Creek, Ont.—According to a statement made by Geo. J. Miller, president of the Miller Independence Mine, the company has decided to construct a first-class road from Boston Creek Station to the mine, for which the contract has already been let. A 16-ft. bridge will also be built.

Calgary, Alta.—The Utilities Board, Edmonton, has approved of the construction of the new Louise bridge over the Bow River at Hillhurst. City engineer, G. Craig.

Dryden, Ont.—On November 6th a conference will be held here to discuss the building of a highway from the head of the Great Lakes to Winnipeg. It will be attended by representatives of the various municipalities interested, including Winnipeg, Fort William and Port Arthur.

Glace Bay, N.S.—A new steel bridge will be erected here. Town engineer, A. McKinnon.

Goderich, Ont.—The town council is considering the widening of South St., between Britannia Rd. and Blake St. Clerk, L. L. Knox.

Golden, B.C.—Tenders will be received by the Honorable the Minister of Public Works, Victoria, B.C., up to noon, November 12th, 1919, for the erection and completion of a highway bridge over the Kicking Horse River at Golden, B.C. Plans and specifications may be seen at the department of public works, parliament buildings, Victoria, B.C.; the office of the district engineer, court house, Vancouver, B.C., and at the office of the assistant district engineer at Golden, B.C.

Hamilton, Ont.—City council intends to undertake the grading of several roads at a cost of $17,481.75. City clerk, S. H. Kent.

Kingston, Ont.—City council passed a by-law for concrete walks on Collingwood and Couper Sts. City engineer, R. J. McClelland.

Laterriere, Que.—A 70-ft. span bridge, with concrete abutments, is being built by the municipality. Tenders will be called for steel superstructure. Engineer, J. F. Tenon, Chicoutimi, Que.

London, Ont.—Forty-seven and one-tenth miles of the streets were oiled this year at a cost of approximately $25,000. This shows an increase of three miles over last year's oiling record, which was 44 miles.

Manitoba, Province of.—At the December elections by-laws will be submitted to the ratepayers of the municipalities of St. Andrews, Brokenhead, Springfield, St. Clements and East St. Paul, authorizing the borrowing on debentures of $552,000 for the construction of 303 miles of gravelled highways at a total cost of $1,152,677.

Oakville, Ont.—The erection of a high-level bridge to replace Aberdeen bridge is being considered by the town council. Mayor, Mr. Davis.

Ottawa, Ont.—The Carleton county council held a special meeting on November 5th to pass a money by-law for the purpose of erecting a bridge on Concession 4, Fitzroy township. County road superintendent, Samuel McClure, Galetta, Ont.

St. John, N.B.—Commissioner Fisher submitted to the city council a programme of street paving for 1920 involving an expenditure of about a million dollars.

St. Louis de Gonzague, Que.—Contract let to Payant and Micheux by the municipality for the construction of a macadam road, estimated to cost $38,000.

Three Rivers, Que.—Tenders will shortly be called for the construction of a road, estimated to cost $12,000. Engineer, Z. Lambert.

Toronto, Ont.—Works Commissioner R. C. Harris has been instructed by the Board of Control to proceed at once with the construction of a new pavement on St. Clair Ave., from the end of the present pavement to Keele St.

Toronto, Ont.—Commissioner of Works R. C. Harris has recommended the extension of Sellers Ave. southerly to Goodwood Ave. at a cost of $6,250.

Toronto, Ont.—The erection by the C.P.R. of a new bridge over the tracks at Main St., East Toronto, is being considered by the Dominion Railway Board; also the construction of a subway at the crossing over the Grand Trunk and the Canadian Pacific tracks at Royce Ave.

Toronto, Ont.—The works committee has approved of the construction of an asphalt pavement on Gerrard St., from Main St. to the east city limit. The probable cost is $182,441. The committee also sanctioned a 24-ft. asphalt pavement on 5-in. concrete foundation on Swanwick Ave., from Main St. to Pickering St., at a cost of $36,720.

Toronto, Ont.—The following contracts have been let for the construction of pavements, sidewalks and curbing: Alvin St., $4,991, Don Crest Rd., $7,761, Weston Rd., $3,481, to Commissioner of Works, City Hall; St. Clarens Ave., $63,451, Weston Rd., $10,822, Constructing and Paving Co., Confederation Life Building; St. Clair Ave., $28,142, Weston Rd., $19,624, Godson Contracting Co., Manning Chambers; Caledonia Rd., $23,578, Warren Bituminous Paving Co. of Ontario, McKinnon Building; St. Clair, $8,873, Grant Contracting Co., 50 Front St. East; concrete sidewalk on Mount Pleasant Rd., $2.23 per sq. yd., Commissioner of Works; concrete curbing on Alvin, Don Crest, Weston Rd. at 75 cents per lineal foot, Godson Contracting Co., Manning Chambers.

Victoria, B.C.—Contract for the construction and erection of a steel viaduct over Deep Creek, on the P.G.E. Ry., seventeen miles north of Williams Lake, has been let by the government to the Canadian Bridge Co., of Walkerville, Ont., at $330,000, this bid being the lowest of four received. The highest bid was $401,000. The viaduct will have a span of

1,160 ft. from abutment to abutment, and will be 300 ft. in height. Some four million pounds of steel will be required.

Victoria, B.C.—City Engineer F. M. Preston has been instructed by the city council to prepare an estimate of the cost of extending and opening up Lang St.

Winnipeg, Man.—City council intends to construct an asphalt pavement on Logan Ave., from East St. to the west side of Blake St. Estimated cost, $9,489. City clerk, C. J. Brown.

Winnipeg, Man.—Sitting as a special sub-committee of the works committee recently, Aldermen Pulford and Fisher heard a deputation urging the city to lend its support to the proposed Vimy highway. It was decided to recommend the works committee to favor the proposed highway across the city, provided no financial obligations for the city are involved. Messrs. Stuart, Atcheson and Kelly composed the delegation.

York Tp., Ont.—A number of street improvements have been authorized by the township council, including the widening of Atlas Ave. Engineer, Frank Barber, 40 Jarvis St., Toronto.

York Tp., Ont.—Township council accepted the tender of the Asphaltic Concrete Co. for the laying of a 24-ft. Tarvia pavement on Millerson Ave., from Glenholme Ave. to Lauder Ave., a distance of 240 ft.

WATER, SEWAGE AND REFUSE

Acton, Ont.—The electors on October 31st carried the waterworks by-law for $80,000. The plant will include deep wells, pumps, pump-house and about four miles of main. The E. A. James Co., Ltd., 36 Toronto St., Toronto, are the engineers. The work will commence at once.

Belleville, Ont.—City council let contract to Wilde and Bumbaca for the construction of sanitary sewers on Queen, Everett, Henry and Cedar Sts. at $9,297.89, and to Wm. Donohue for the construction of sanitary sewers on West Moira, North Front and Grove Sts. for $15,266.19.

Blenheim Tp., Ont.—Tenders will be received by Hugh Allan, township clerk, Drumbo, Ont., up till noon on Saturday, November 8th, for the furnishing of 287 ft. of 4-in. tile, 555 ft. of 5-in., 1,175 ft. of 6-in. and 1,064 ft. of 8-in. tile, delivered at Richwood Station; also for the performance of the work required in the construction of the Burns drain, in the township of Blenheim. Plans and specifications may be seen at the clerk's office in Drumbo.

Drumheller, Alta.—Municipality plans water main extensions at an estimated cost of $5,000. Clerk, H. A. Brown.

Kingston, Ont.—City council passed a by-law for the construction of a sewer on Russell St. City engineer, R. J. McClelland.

Kitchener, Ont.—Kitchener and district are interested in the fact that among the recommendations by the Soldiers' Re-establishment Commission is a clause urging an investigation of the irrigation small land holding scheme suggested by N. Cauchon, engineering expert, of Ottawa, who recommends the Hamilton district. The plan would necessitate a conservation of the waters of the Grand River and the building of big dams in the territory north of the city. The idea originated with a local civil engineer, W. S. Breithaupt.

Lindsay, Ont.—Council will proceed with the construction of a storm sewer on Victoria Ave. Town engineer, Oliver Smith.

Owen Sound, Ont.—The Public Utilities Commission has requested the town council to pass a by-law authorizing the issue of $10,000 worth of debentures for the construction of a filter bed and other extensions. City clerk, Chas. Gordon.

Peterboro, Ont.—City council decided to install a sewer on Park St., from Cedar St. to the creek south of McDonnel St. City engineer, R. H. Parsons.

Saskatoon, Sask.—City council decided to have the ratepayers vote at the December elections on the question of a suitable site for the proposed incinerator. Pending their decision, action on the plans will be deferred. In the meantime, the city council is looking into a proposition, submitted by Dr. J. A. Armstrong, of the Saskatchewan Oakoal Co., Ltd., to press all the garbage into briquettes to be used as a substitute for coal. Dr. Armstrong stated that all the city was required to supply was a skeleton building and the garbage and the company would do the rest, installing a $40,000 plant.

Scarboro' Tp., Ont.—The council have instructed the E. A. James Co., Ltd., 36 Toronto St., Toronto, to proceed at once with detailed plans and specifications for an intake, pump-house and filter-house with a capacity of 2,000,000 gallons. The plant will be situated south of Birch Cliff, and will serve that part of Scarboro' west of the Kennedy Rd. and south of St. Clair. Such work as can be done during the winter will be started at once. The installation will cost some $300,000.

St. John, N.B.—City council may have a water main laid to Spruce Lake. City engineer, G. N. Hatfield.

St. Vital, Man.—The rural municipal council intends to sink a public well on the north side of Sadler Avenue. E. A. Poulain, secretary-treasurer.

Timmins, Ont.—Work on the installation of the new sewage and water systems is being pushed forward with all possible haste. In all, 23,000 ft. of sewer line, ranging from 8-inch to 18-inch, has been planned, including 6,400 ft. of trunk line, extending from the boundary down to where the disposal plant will eventually be located, some distance past the junction of the Mountjoy and Mattagami river. The remaining 16,600 ft. will serve all residences in the town. To date, there remains about 5,000 ft. of sewer line to be completed. The original plans for the construction of the sewage disposal plant are to be revised shortly, and work will likely be commenced next spring. The plans for the water pipe line call for approximately 9,600 ft. Of this, 4,500 ft. have yet to be completed. The engineering work is in the hands of Sutcliffe and Neelands.

Vancouver, B.C.—The Board of Works has approved of the following sewer extensions: City's main sewer, from St. George to Carolina Sts., and thence to the lane east, estimated cost, $4,430; two blocks, between Burns and St. Catherines St., $3,576, and a half block on Fourteenth Ave., between Cedar and Pine Sts., $500. City engineer, F. L. Fellowes.

Walkerville, Ont—The Walkerville Water Co., Ltd., have awarded contract to the Turbine Equipment Co., Ltd., Toronto, for a 450 h.p. De Laval steam turbine-driven geared pump, with a capacity of 5 M.G.D.; domestic head, 165 ft.; fire head, 315 ft.

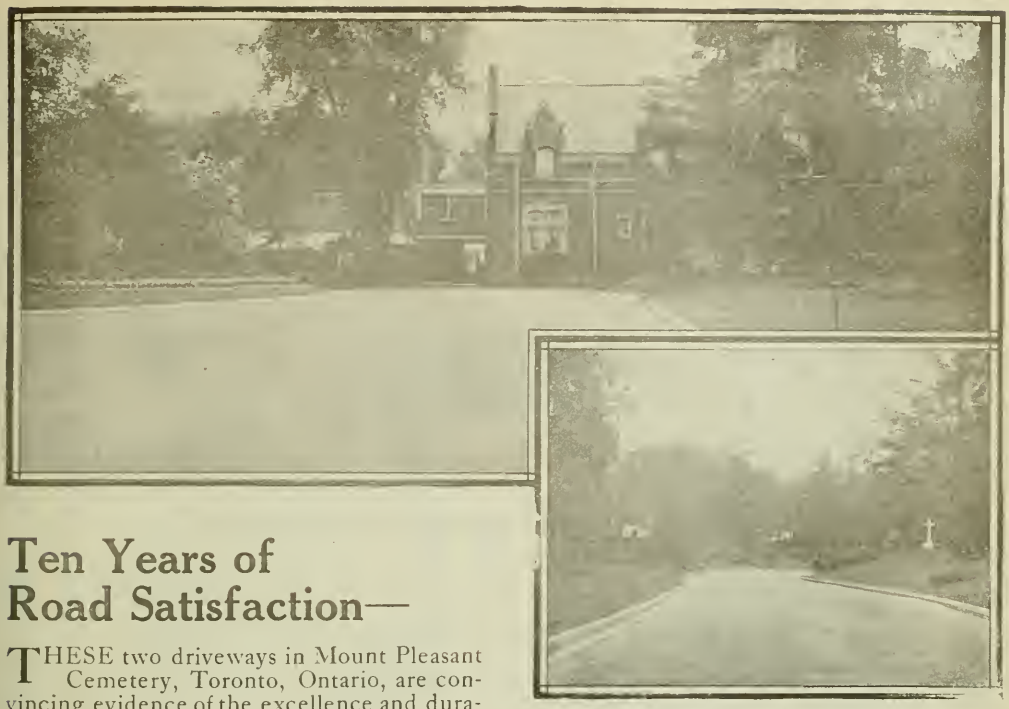
Winnipeg, Man.—Contract let by the city council to the Dominion Construction Co. for a water main on Myrtle St.

Winnipeg, Man.—City council intends to construct a sewer in Pritchard Ave., from Prince St. eastward to the C.P.R. Selkirk branch. Estimated cost, $1,350. City clerk, C. J. Brown.

Winnipeg, Man.—At a recent meeting of the water board, it was agreed that immediate steps should be taken to under-drain the Greater Winnipeg water aqueduct. The cost will be from $400,000 to $750,000. It was decided to have the five consulting engineers who have made reports on the necessity of the work attend the next meeting of the board. W. G. Chace, chief engineer, urged that tenders be called for now, so that an early start could be made in the spring. The board decided not to build a 250,000,000-gallon reservoir at Deacon.

York Tp., Ont.—The township council passed a by-law whereby the funds necessary to go ahead with the waterworks construction programme will be temporarily advanced by the Canadian Bank of Commerce.

York Tp., Ont.—Township council adopted the report of F. Barber, township engineer, on a number of water mains, and also instructed the waterworks superintendent to call for tenders for the purchase of 500 service meters.



Driveways of old macadam in Mount Pleasant Cemetery, Toronto, Ont., resurfaced with "Tarvia-X".

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Woodstock, Ont.—Ald. Parker, chairman of the special sewer committee, reported to the city council that the cost of the proposed new intercepting sewer is estimated at $41,-312, and of the sewage disposal plant at $51,983. Council decided to submit the report to the Provincial Board of Health for approval, and to have a by-law prepared to submit to the electors as soon as the Board's approval is secured.

York Tp., Ont.—The township council gave the first reading to a by-law to authorize F. Barber, township engineer, to take preliminary proceedings to install a water main and service pipe on Montye Ave., from Willard Ave. easterly to Jane St., and on Windermere Ave., from Morningside Ave. southerly.

LIGHT, HEAT AND POWER

Calgary, Alta.—The extension of telephone lines in this city and the erection of new buildings and sub-exchanges is planned by the Provincial Government Telephone Department. Deputy Minister of Railways and Telephones, Norman Harvey, Edmonton.

Edmonton, Alta.—The Utilities Committee may find it necessary in the near future to purchase new machinery for the power plant. Chairman, Ald. J. A. Kinney.

Montreal, Que.—Tenders for briquetting machinery will be received by the Lignite Utilization Board of Canada at its office, 80 St. François Xavier St., Montreal, until 12 o'clock noon, December 14th, 1919. Specifications may be obtained from Lesslie R. Thomson, secretary of the Lignite Utilization Board.

New Liskeard, Ont.—Sutcliffe and Neelands, of New Liskeard, and McCarthy and Porter, of Elk Lake, are looking into the question of developing Hydro-electric power at the Indian chute on the Montreal River, about 12 miles above Elk Lake, to supply the surrounding mining district. It is considered that 5,000 h.p. can be made available at this point. It is also stated that private enterprise will provide a railway. In fact, it is believed that the contract has been already signed, and that work will begin in the spring.

Regina, Sask.—A representative meeting of ratepayers passed a resolution, practically unanimously endorsing the natural gas franchise by-law. Commissioner Thornton estimates the cost of the pipe line, assuming the length to be 200 miles, at $5,000,000.

Waterloo, Ont.—Manager Schiedel, of the Waterloo Water and Light Commission, has notified the Hydro-Electric Power Commission to have plans and specifications prepared for the proposed addition to the power house here, after which tenders will be called for.

RAILWAYS

London, Ont.—A by-law to authorize the purchase of the Street Railway by the city will be submitted to the ratepayers at the next municipal election, providing the city council adopts the suggestion of Mayor C. R. Somerville.

Montreal, Que.—City commissioners will insist on the Tramways Commission ordering the Tramways Co. to construct a stub line from Atlantic Ave. along Beaumont St. and up Bremner St., construction to commence next spring.

St. Catharines, Ont.—In a conference with the civic authorities, D. B. Hanna, of the Canadian National Railways, has offered, in return for the extension to 1937 of the franchise of the electric lines in this city and district, now under control of the government, to build a $50,000 station, extend city lines and shorten the route to Welland.

Windsor, Ont.—The plans of the Hydro-Electric Power Commission of Ontario to purchase the Sandwich, Windsor and Amherstburg Ry. for $2,100,000 were unanimously approved by the border municipalities.

FACTORIES AND LARGE BUILDINGS

Baintree, Alta.—Tenders will be received by the Board of Trustees of Baintree School District, No. 3804, at the office of H. Kruse, Edmonton, secretary-treasurer, up to noon, November 18th, 1919, for the erection of a frame school building. Plans and specifications may be seen at the offices of the secretary-treasurer, Baintree; J. A. McGregor, 3735 7th St. West, Calgary, and the Department of Education, Edmonton.

Belleville, Ont.—The Chemical Products Corporation, Ltd., Toronto, propose to spend about a million dollars on the construction of a plant here.

Brantford, Ont.—A permit for the erection of a factory for Robbins and Meyers, in the Holmedale district, Brantford, has been applied for. The cost of the new building is estimated at $150,000, and the dimensions are 80 ft. by 411 ft.

Bridgeburg, Ont.—The Brazil Motors Co., of Brazil, Indiana, a $2,000,000 industry, is looking for a site for the establishment of a Canadian plant. Both Bridgeburg and Welland are being considered.

Brockville, Ont.—Returned soldiers of Brockville and points in Leeds and Grenville counties at a meeting held here urged the erection of a Great War Veterans' clubhouse as a permanent war memorial for these counties.

Calgary, Alta.—A permit has been issued to Lougheed and Taylor for the erection of a garage on Ninth Ave., between First and Second St. West at a cost of $30,000.

Calgary, Alta.—By-laws to authorize the following expenditures are being prepared and will shortly be submitted to the city council for approval: Children's shelter, $60,000; waterworks extension, $207,345; sewage disposal plant, $350,000; hospital extension, $120,000.

Edmonton, Alta.—Tenders on the general construction, plumbing and heating and electrical work for the new telephone building were recently opened by the City Commissioners. In all cases they were referred to the city architect for tabulation and report. The lowest bid on the general building work was $78,753, submitted by the E. N. Nesbitt Co. Other tenders were: J. Dunlop, $82,105; H. G. McDonald, $82,222; Speers and MacAfee, $106,570. Tenders submitted for the plumbing and heating work were as follows: Lockerbie and Hole, $12,723; S. L. Dobbin and Co., $12,910; Kelly and Kokott, $13,277; Standard Heating and Plumbing Co., $13,109; Ross Brothers, $13,859; McKnight and Frost, $14,419; Ideal Heating and Plumbing Co., $15,-221. On the electrical work the Hillas Electric Co. tendered $2,997.65 and Bert L. Perry, $2,546.

Edmonton, Alta.—Contract let by Carroll-Wilson, Ltd., to McDougall, Trainer, McNeill, Ltd., Sugarman Building, Edmonton, for the erection of a one-story brick building at the corner of 102nd Ave. and 108th St.

Fort William, Ont.—It is stated that the C.P.R. Co. will submit a proposition to the city council which involves something like $2,000,000 in the erection of a railway hotel in this city. It is understood that if the proposition is submitted it will be voted on by the ratepayers at the January elections.

Galt, Ont.—The Perfect Machinery Co. will enlarge their building if the city will grant the company a $20,000 loan. A by-law will be submitted to the ratepayers.

Glace Bay, N.S.—School Board decided to call for tenders at once for the erection of a new Central School.

Grand' Mere, Que.—A movement is on foot for the erection of a Technical School.

Guelph, Ont.—The Chamber of Commerce is engaging in a programme for the establishing of new industries in the city. Of the concerns approached, four have intimated their readiness to build their plants at Guelph, providing the city is prepared to meet their offers.

Hamilton, Ont.—The sum of $74,800 will be advanced to the city by the Ontario Housing Commission for housing purposes.

BURLINGTON

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Hamilton, Ont.—The British-American Oil Co. have been granted a permit to erect a concrete stable and garage on Burlington St. East at a cost of $8,000.

Hamilton, Ont.—The Dominion Canners, Ltd., have purchased a site of six acres in extent in the east end of this city. It is stated that the company intend to erect a $1,000,000 plant.

Hamilton, Ont.—Engineers of the Norton Co., of Worcester, Mass., were in the city recently letting contracts for the buildings which this company will erect here at the foot of Lottridge St.

Kingston, Ont.—Tenders addressed to the secretary, Board of Education, will be received up to noon, November 11th, 1919, for the erection of a Public School. Plans and specifications may be seen at the offices of the Board and the architects, Power, Son and Drever, Merchants Bank Chambers, Kingston.

London, Ont.—The city may erect large barns on its property at the corner of Waterloo and Horton Sts. next year at a cost of approximately $50,000. This question will be placed before the electors at the January elections for approval.

Maillardville, B.C.—The erection of a new municipal hall is under contemplation by the municipal council.

Moose Jaw, Sask.—Final plans for the new C.P.R. depot here show an approximate expenditure of $450,000. Engineer in charge of buildings for C.P.R., D. H. Mapes, Montreal.

Moose Jaw, Sask.—A campaign has been opened by the Great War Veterans for funds for the erection of a proposed Home and Memorial Hall. Chairman of Special Committee, W. McAllister. Estimated cost, $170,000.

North Vancouver, B.C.—A movement is on foot for the erection of a new public hospital. Clerk, J. G. Farmer.

Oakville, Ont.—Greenberg and Lentner Co., hat and cap manufacturers, may erect a factory here.

Oakville, Ont.—Alterations which will cost in the neighborhood of $35,000 are being made to the Presbyterian church. A 47-ft. Sunday School addition is being built at the rear, and a new church and vestry will be erected. W. H. Hocks is the general contractor.

Ottawa, Ont.—The question of erecting a memorial hall at a probable cost of $500,000 in connection with the new city hall, which must be erected in Ottawa in the immediate future, was submitted to the city council by the special committee appointed to consider the matter. If the council agrees, the ratepayers will be asked to vote on the matter at the January elections. Chairman of Special Committee, Capt. W. P. Grant.

Owen Sound, Ont.—Town Engineer Fleming has prepared plans for proposed improvements and alterations to the municipal building estimated to cost $5,000.

Owen Sound, Ont.—Plans are under consideration by the civic authorities for the construction of a new fire hall, including a central heating plant. Clerk, Chas. Gordon.

Penetanguishene, Ont.—The sawmill of the McGibbon Lumber Co. was totally destroyed by fire recently. Loss, $25,000.

Peterboro', Ont.—The old Cordage Co.'s buildings have been taken over by the city and $6,700 will be spent on repairs.

Petrolia, Ont.—A movement is on foot by the directors of the Corn Growers' Association, Live Stock Association and Poultry Association for the erection of a new winter fair building.

Portage la Prairie, Man.—Plans are under way for the erection of a rink, estimated to cost $10,000. Further information from W. R. Sexsmith.

Port Haney, B.C.—The erection of a fruit cannery and box factory here by Gillan and Edgett, of Vancouver, is announced.

Regina, Sask.—The Poole Construction Co. is erecting a warehouse at the corner of Hamilton and Eighth Ave. at a cost of $20,000.

Regina, Sask.—Contract let to the Poole Construction Co. for the erection of a $12,000 warehouse for the Winnipeg Ceiling and Roofing Co.

Regina, Sask.—The Merchants Bank of Canada will erect a new bank and office building on Eleventh Ave., between Scarth and Cornwall Sts. The building will be of dressed stone, steel and brick construction, fireproof throughout, and will cost over $75,000. Local manager, John J. Galloway.

Renfrew, Ont.—Renfrew has carried a $25,000 by-law for the construction of a new fire hall in which will be installed a central heating plant. Clerk, J. A. Devenny.

Rossland, B.C.—The Consolidated Mining and Smelting Co. of Canada will erect a large concentrator either at Trail or Rossland. The plant, which will involve an outlay of $1,000,000, will have an area of about an acre. The buildings will probably be of steel, with gunnite walls and concrete floors.

Sarnia, Ont.—Board of Education approved the plans for the erection of a one-story portable school.

Saskatoon, Sask.—A by-law will likely be submitted to the ratepayers at the next elections authorizing the issue of debentures to cover the construction of a hospital estimated to cost $200,000. City commissioner, C. J. Yorath.

South Vancouver, B.C.—It is probable that the proposed new High School will be located at the municipal grounds.

Squamish, B.C.—Mr. Hudson, of Everett, Wash., is investigating the feasibility of establishing a pulp and paper mill here.

St. Boniface, Man.—The Prest-O-Lite Co. will erect a new battery plant factory and offices.

St. Catharines, Ont.—Hon. Dr. Cody, Minister of Education, has notified the Collegiate Board that the government grant to the school will be paid this year on condition that the board, within the next three months, buys a site for a new school building. The question will likely be submitted to the ratepayers at the January elections.

St. John, N.B.—School Board proposes to erect two new schools.

St. Thomas, Ont.—Plans for a modern Labor temple, to be built by the I.L.P., of this city, and the U.F.O., of West Elgin, are now under way.

St. Thomas, Ont.—The Canada Iron Foundries have been granted a permit to erect a building at the corner of Woodworth and First Aves. at a cost of $12,000.

St. Thomas, Ont.—Contracts for the erection of a bank building at the corner of Flora and Talbot Sts. for the Molsons Bank have been let to local contractors as follows: General contract, A. E. Ponsford, Ltd.; plumbing and heating, Hamilton and Stott, and electric wiring, Roberts and Sandham.

Sydney Mines, N.S.—The Royal Bank of Canada proposes to erect a building here to cost approximately $60,000.

Toronto, Ont.—The first constructive work on the new Electrical Building, University of Toronto, has been commenced.

Toronto, Ont.—George E. Gooderham has been granted a permit to build an $85,000 garage on the west side of Sheppard St., near Richmond St.

Toronto, Ont.—The veto was put on the plan to erect a couple of public lavatories at a cost of $15,000 at Hanlan's Point by the Board of Control.

Toronto, Ont.—The north-east corner of Lee Ave. and Queen St. East has been purchased by the Canadian Bank of Commerce as a site for a branch bank.

Toronto, Ont.—City Architect Pearse has issued a permit to the Chase Tractor Co. for the alteration of their building at 28 Atlantic Ave. at a cost of $40,000.

Toronto, Ont.—A permit has been issued to the Ideal Bedding Co. for alterations and addition to their factory on the west side of Jefferson Ave. at a cost of $80,000.

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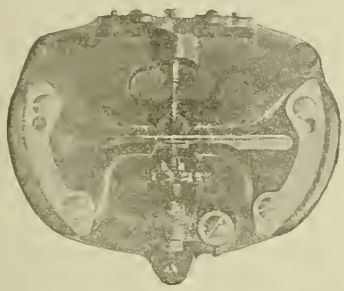

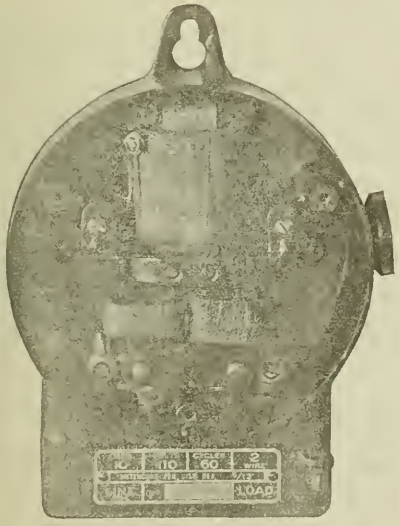

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Toronto, Ont.—Joseph Price and Sons have been granted a permit for the erection of 72 semi-detached private garages on the south-west corner of Woodbine Ave. and the Kingston Rd. at a cost of $4,300.

Toronto, Ont.—At a recent conference at Hamilton of those interested in the establishment of a large winter live stock show, Toronto was decided on as against Hamilton for the site. It will be located at the Exhibition Grounds. The project involves the expenditure of about $1,000,000.

Toronto, Ont.—Hon. Dr. Cody, Minister of Education, recently announced that under the joint Federal and Provincial scheme for encouraging technical and industrial education, grants are to be paid to municipalities to the extent of 50 per cent. of the cost of buildings and equipment especially provided for technical and industrial day or evening schools and classes.

Toronto, Ont.—Parks Commissioner Chambers has recommended the expenditure of $30,000 out of next year's estimates upon the erection of a shelter and public lavatories in the Hanlan Memorial Park. Commissioner Chambers also intends to submit plans for similar buildings in Island Park and High Park at an estimated cost of $50,000 each, in Riverdale Park at $30,000 and in Reservoir Park at $20,000.

Toronto, Ont.—The Advisory Industrial Committee of the Board of Education has concurred in the recommendation of Dr. A. C. McKay, principal of the Central Technical School, that $200,000 be placed in the estimates for 1920 to provide one-half the cost of the erection and equipment of a branch Technical School on Greenwood Ave., Riverdale.

Toronto, Ont.—City council proposes to build a new administration building on Albert St. for the police department and court rooms to relieve the congestion in the city hall. Chief Grasett and two of the police commissioners will visit cities in the United States with a view to ascertaining ideas for the erection of new quarters.

Trenton, Ont.—Work will start at once on the erection of a skating rink. Clerk, J. W. Delany.

Vancouver, B.C.—A scheme is under way here for the erection of a co-operative apartment house at a cost of nearly $600,000.

Vancouver, B.C.—The erection of new buildings for the Boys' Industrial Home at Jericho are being considered by the provincial government. Provincial secretary, Hon. J. D. MacLean.

Vancouver, B.C.—A permit for the construction of a one-story building for a machinery storage warehouse has been taken out by the British Columbia Sugar Refinery Co. Estimated cost, $2,000.

Waterford, N.S. — The Dominion Steel Corporation, through President Mark Workman, has donated $25,000 towards the erection and establishment of a General Public Hospital here. It is understood that work on the proposed hospital will begin immediately.

Windsor, Ont.—Plans have been prepared by A. H. McPhail, architect, for the erection of a school estimated to cost $400,000. Reinforced concrete and steel construction.

Winnipeg, Man.—Contract let to Thomas Kelly and Sons to construct a showroom at the City Light and Power Building. Estimated cost, $23,000.

Winnipeg, Man.—The Dominion Bank has purchased the north-west corner of Kennedy St. and Portage Ave. and next spring will proceed with the erection of a handsome bank building.

Winnipeg, Man.—The city council granted the Grey-Ogeltree Motor Co. permission to erect a public garage, 100 ft. by 140 ft., on the east side of Burnel St., between Portage Ave. and St. Paul Ave.

Woodstock, Ont.—The Brunswick Canadian Products Co. will erect a $200,000 plant here. Further information from President Rea, of the Board of Trade.

York County, Ont.—The Great War Veterans' Association is urging upon the county council the erection of a clubhouse.

York Tp., Ont.—The township council will shortly issue $200,000 worth of debentures to cover the cost of the erection of two schools in School Section No. 15.

York Tp., Ont.—Tenders will be received by John A. Martin, secretary, York Township Housing Commission, 40 Jarvis St., up to 12 o'clock noon, Wednesday, November 12th, for the furnishing of material and the erection of 15 brick dwellings.

MISCELLANEOUS

Calgary, Alta.—The commissioners recommended to the city council the installation of a complete new fire alarm system at the General Hospital at an estimated cost of $1,875. City clerk, J. M. Miller.

Deseronto, Ont.—The town council awarded a contract to Harry Hall to install a new fire alarm system for the town.

Glace Bay, N.S.—The question of a drydock for Glace Bay will be presented to the Dominion government by the Harbor Committee, of which Stuart McCawley is chairman.

Saskatoon, Sask.—The following by-laws will be submitted to the ratepayers on December 8th: New pumps at pumping station, additional expenditure, $7,000; 4,500 k.w. turbine, additional expenditure, $60,000; grading road along river bank, from Avenue H to G.T.P. bridge, $5,000. City commissioner, C. J. Yorath.

St John, N.B.—Work is being pushed on the Courtenay Bay drydock and breakwater by the St. John Drydock and Shipbuilding Co. It is anticipated that a British shipbuilding firm will establish a mammoth plant in the vicinity of the drydock.

Toronto, Ont.—The Board of Control instructed the Parks Commissioner to submit a report, showing his plan of improvements for the Don River and ravines from the harbor improvements to the northern city limits, providing for a boulevard, acquisition of C.N.R. yards from the government and securing of ravines on right-of-way of the belt line to the northern city limits for a boulevard scheme and driveway similar to the civic programme on the Humber.

Toronto, Ont.—According to a statement recently made by Mayor Church, the following are among expenditures contemplated by the city council: New live stock arena, $1,000,000; new schools and sites, $1,500,000; new court house, about $1,500,000; harbor improvements, $2,000,000.

Toronto, Ont.—The provincial government has granted charters to the following companies: Farmers' Mining Co., Ltd., Toronto, capital $50,000; J. K. Carroll Construction Co., Ltd., Kingston, $40,000; Crookston Quarries, Ltd., Crookston, $300,000; Northern Ontario Great Mines Developing Co., Ltd., Hamilton, $2,000,000; Ontario Tie, Timber and Construction Co., Ltd., North Bay, $350,000; E. A. Lowry Power Equipment Co., Ltd., Guelph, $50,000; Skead Gold Mines, Ltd., Toronto, $5,000,000; Central Electric Supply Co., Ltd., Toronto, $150,000.

Toronto, Ont.—Tenders for annual supplies were opened by the Board of Control on Thursday, October 30th, and were all referred to the departments concerned for report on samples, etc. The prices were as follows:—

Asphalt.—Tender No. 1—$17.50 in tank cars, $23.75 in packages; No. 2, $48.56 packages; No. 3, $21.67 tank cars; No. 4, $20.23 tank cars, $26.10 packages.

Block, Vitrified Paving.—Tender No. 1, 3-in., $47.50; 4-in., $51.

Castings, Brass and Bronze.—Tender No. 1, 35c. phosphor-bronze, 35c tobin-bronze, 30c. brass; Tender No. 2. 46¼c. phosphor-bronze, 42½c. tobin-bronze, 43¾c. brass; Tender No. 3, 65c. phosphor-bronze, 37¼c. brass.

Pipe, Lead, per 100 lbs.—Tender No. 1, $10.25; Tender No. 2, $10.50; Tender No. 3, $10.50.

Water Pipes, Cast-iron, per length.—Tender No. 1, $7.60 for 3-in.; $9, 4-in.; $15, 6-in.; $20.25, 8-in.; $28.50, 10-in.; $38.60, 12-in.

Hydrants.—Tender No. 1, $107.26; Tender No. 2, $109; Tender No. 3, $102.

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Valves, Stop.—Tender No. 1, $27.65, 3-in.; $33.15, 4-in.; $38.30, 6-in.; $68.40, 8-in.; $111.40, 12-in. Tender No. 2, $15.10, 4-in., with sockets; $16.78, 4-in., with flanges; $26.70, 6-in., with sockets; $28.50, 6-in., with flanges; $40.27, 8-in., with sockets, $43.20 with flanges; $72.14, 12-in., with sockets, $80.32 with flanges; Tender No. 3, $26, 3-in.; $31.25, 4-in.; $35.25, 6-in.; $62.50, 8-in.; $104.50, 12-in.; Tender No. 4, $32.50, 6-in., with sockets; $36.25, 6-in., with flanges; $72, 8-in., with sockets, $80 with flanges; $81.10, 12-in., with sockets, $90 with flanges.

Wood Block, Treated.—Tender No. 1, $2.06, 3 x 3-in. long-leaf yellow pine; $2.36, 3 x 3½-in.; $2.06, 3 x 4-in., plain blocks, $2.61, 4 x 4-in.; $2.51, 3 x 3½-in. lug, $2.21, 3 x 4-in., $2.76, 4 x 4-in., f.o.b. Mobile, Ala. Tender No. 2, $3.06, 3 x 3-in.; $3.48, 3 x 3½-in.; $3.87, 3 x 4-in.; $3.29, 3 x 3-in. lug blocks; $4.11, 3 x 4-in.

Liquid Chlorine, per ton.—Tender No. 1, $2.75; Tender No. 2, $2.40.

Mineral Dust.—Tender No. 1, $6.65 per ton.

Vancouver, B.C.—At a recent meeting held by the Harbor Board to hear the views of the members of the Shipping Federation on general harbor improvements, the federation went on record as being unanimously in favor of placing the improvements on Burrard Inlet. The present improvements suggested are a double-deck fireproof dock, 1,200 ft. long, with two two-story freight sheds at least 125 ft. in width, to extend the full length of the pier, and to be equipped with internal elevators and outside cranes. The Shipping Federation also considers it absolutely necessary that first-class drydock facilities be installed. Chairman of the Harbor Board, Mr. Kirkpatrick.

Victoria, B.C.—The provincial government has granted certificates of incorporation to the Canadian Water Wheel Co., Ltd., Vancouver, capitalized at $100,000, and the Campbell Rotary Pump Co., Ltd., Vancouver, also with a capital stock of $100,000.

Tenders Called For

LIGNITE UTILIZATION BOARD OF CANADA

Sealed tenders for briquetting machinery will be received by the Lignite Utilization Board of Canada at its office, 80 St. François Xavier Street, Montreal, P.Q., until 12 o'clock noon, December 14th, 1919.

Each tender must be made upon the proposal form provided, and must be accompanied by all the information required.

Copies of specifications and form of proposal may be obtained from the Secretary of the Lignite Utilization Board upon application.

The Lignite Utilization Board of Canada does not bind itself to accept the lowest or any tender.

LESSLIE R. THOMSON, Secretary. R. A. ROSS, Chairman.

Montreal, P.Q., November 1st, 1919. 373

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CONSTRUCTION ENGINEER.—Young engineering graduate, whose experience has been mostly in the contracting field, to take charge of branch office in Toronto. Knowledge of purchasing materials required. J. B. Nicholson, Limited, Hamilton, Ontario. 371

MANUFACTURER in Eastern Townships, having good facilities and considerable experience in the production of a wide variety of machinery lines, desires to undertake the manufacture (for the Canadian or export trade) of American or English machinery. Full particulars gladly upon request. Box 396, *Canadian Engineer*, Toronto.

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PATENT NOTICE.—Anyone desiring to obtain the invention covered by Canadian Patents Nos. 161,048 and 161,049, granted on March 2nd, 1915, to Arthur Heinsmann, of West Kensington, London, W., England, for Propylene Production and Glycerine Production, may do so upon application to the undersigned, who are prepared to supply all demands on the part of the public for the invention and from whom full information may be obtained. Fetherstonhaugh & Co., 5 Elgin Street, Ottawa, Canada. Russel S. Smart, resident. 372

In accordance with a request received from the city councils of Port Arthur and Fort William, Ont., it was stated last week at the head office of the Hydro-Electric Power Commission of Ontario that steps will be taken at an early date to secure an expert valuation of the street railway system at the head of the lakes. The decision to have the "Hydro" undertake this work was reached at a joint meeting of the two councils.

The Canadian Engineer

A Weekly Paper for Civil Engineers and Contractors

Hydro-Electric Power Development at High Falls

Net Head of 80 ft. Utilized at Power Site on the Mississippi River by the Hydro-Electric Power Commission of Ontario—Details of Dam, Intake, Gate House, Pipe Line and Power House—Surface Area Method of Proportioning Materials Shows Excellent Results in Construction of Concrete Dam

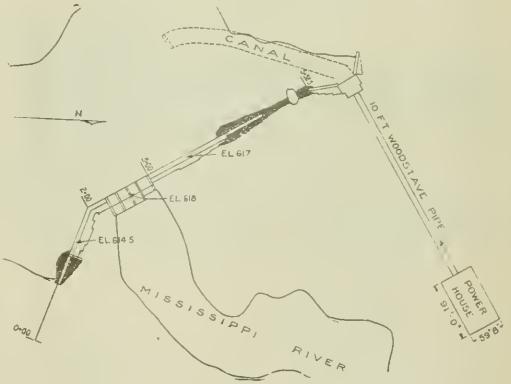
AT HIGH FALLS, on the Mississippi river, in the southern part of Lanark county, Ont., about 25 miles northeast of Perth and ½ mile above Dalhousie lake, the Hydro-Electric Power Commission of Ontario is developing a power site and installing hydro-electric machinery with total capacity of 3,600 h.p. This plant will be the fifteenth generating station to be owned by the "Hydro" Commission, and two others are also under construction, the Nipigon plant (see *The Canadian Engineer*, June 12th, 1919, issue) and the great Queenston undertaking (see the following issues of *The Canadian Engineer*: August 28th, 1919; November 21st, 1918; September 26th, 1918; and June 20th, 1918). The fourteen other plants owned by the "Hydro" are the following:—

Wasdell's Falls, Eugenia Falls, Nipissing Power Co., Erindale Power Co., Trenton, Campbellford, Frankford, Auburn, Fenelon Falls, Carleton Place, Ontario Power Co., Big Chute, Healy Falls and South Falls.

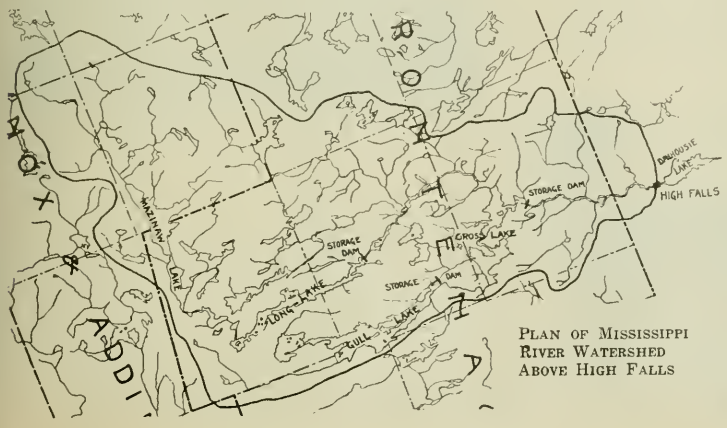
The first two mentioned—Wasdell's Falls and Eugenia Falls—were constructed by the "Hydro," but all of the others were purchased from the former private owners, although in the case of the four last-mentioned plants, the "Hydro" has built extensive additions.

The drainage area of the Mississippi river above High Falls is approximately 450 square miles. The first complete year for which run-off records were obtained by the "Hydro" was November, 1915, to November, 1916, for which twelve months the maximum run-off was 2,940 c.f.s., and the minimum 214 c.f.s., with a mean of 776 c.f.s., or a run-off depth of about 23 inches on the drainage area. For the following year, the maximum run-off was 2,060 c.f.s., the minimum 72 c.f.s., and the mean 426 c.f.s., or a run-off depth of about 12.8 inches on the drainage area. For the year November, 1917, to November, 1918, the maximum run-off was 2,530 c.f.s., the minimum 186 c.f.s., and the mean 499 c.f.s., or a run-off depth of about 15 inches on the drainage area. The watershed is still fairly well forested. The average run-off for the three years recorded was 567 c.f.s.

The plant that is being installed requires 540 c.f.s. when operated at maximum capacity. The water is used under 80 ft. net head. There are three horizontal, double-runner double-discharge hydraulic turbines; one of them is connected to a single generator, but each of the other two turbines drives a generator at each end of its shaft. This is not a matter of present design, but is due to the fact that



GENERAL PLAN OF HIGH FALLS DEVELOPMENT



PLAN OF MISSISSIPPI RIVER WATERSHED ABOVE HIGH FALLS

practically all of the hydraulic and electrical machinery for this plant was purchased at a low price, as used equipment, from the Hannawa Falls Power Co., of Potsdam, N.Y.

There is ample storage area above High Falls, as the Mississippi river flows through a chain of many lakes of various sizes, including Cross, Gull, Long, Mazinaw, Mud, Mississagagon, Kashwakamak, Buckshot and Grindstone lakes. The required storage dams on these lakes are already built and are owned and operated by the Mississippi Improvement Co., a private company that was organized by the power users who have developed other sites further down the river. The expenses of the Improvement Co. are met by assessments on all of the power users on the river, in

Excavation for Canal, Looking Downstream

proportion to the power developed. The Improvement Co. has acquired the necessary flowage rights on the various lakes. The chief storage dams are those at the outlets of Cross, Gull and Long lakes, and are rock-filled timber cribs. There is also a pondage area of over 500 acres behind the new concrete dam that is being built at High Falls by the "Hydro," this dam also increasing the available head by approximately 12 ft. The "Hydro" purchased the power site at High Falls two years ago from its private owner. The "Hydro" was already a member of the Improvement Co., on

Looking Upstream Above Dam Site

account of its ownership of the Carleton Falls plant further down the Mississippi river.

The accompanying general plan of the development indicates that the concrete dam at High Falls consists of a sluiceway section 76 ft. long, flanked on the south by an overflow section 104 ft. long, and on the north by a gravity section 112 ft. long, and terminating at the south in a core-wall section 38 ft. long and at the north in a core-wall section 140½ ft. long, the north core-wall section being sealed to the gate house by a wing wall 40 ft. long.

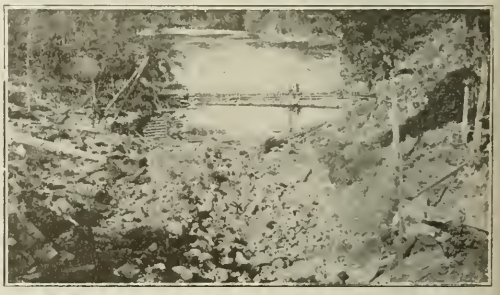
Looking Downstream Below Dam Site

The total length of the dam and wing wall is about 510 ft. This is about the correct length of the whole dam as constructed, but since the lay-out was made from which the accompanying general plan was copied, the dam was located slightly further upstream, with a consequent lengthening of the overflow section and a shortening of the northern core-wall section. The overflow section as constructed is also more nearly on a straight line with the remainder of the dam than is indicated by the accompanying general plan.

The four sluiceways each have a 14-ft. clear opening. Each of the four rollways is 8 ft. 7¼ ins. wide at top, with a batter of 9 in 12. The reinforced concrete deck is 17 ft. 4 ins. wide. The height of the top

Portion of Sluiceway Section of Dam, Showing Three of the Four Rollways

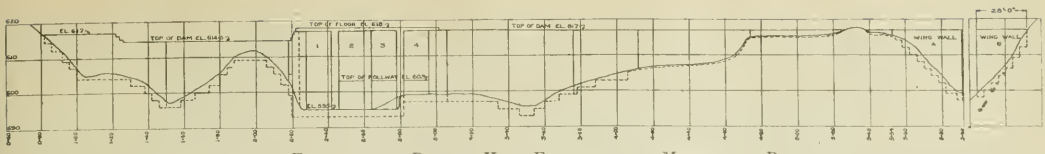
of the deck above the base of the dam is about 26 ft. for sluiceways Nos. 1, 2 and 3, and about 22 ft. for sluiceway No. 4. The clearance from the top of the rollways to the deck is 14 ft. 2 ins. The deck is 10 ins. thick. The piers have a batter of 7½ in 12. The overflow section has a top width of 4 ft. 5½ ins., and a batter of 7 in 12. The gravity section has a top width of 3 ft. and a batter of 7 in 12. The core walls have a maximum thickness of 2 ft., and a minimum thickness of 1 ft. The rock fill is 6 ft. wide at top and has



Power House Site Before Unwatering, Looking Along Pipe Line

a 1 to 1 slope on each side. The whole dam rests upon a rock foundation.

A canal, or intake channel, has been excavated for a distance of about 247 ft., extending upstream from the gate house at the north end of the dam. After the removal of the cofferdam that was built in order to divert the flow of the river and so unwater the site of the dam, this channel will be entirely under water excepting for a distance of 150 ft. from the gate house. The bottom of the canal is 8 ft. wide, and the sides are sloped 1½ to 1. The bottom and sides are protected by riprap excepting where they are in solid rock. The bottom of the canal is level for 100 ft. from the

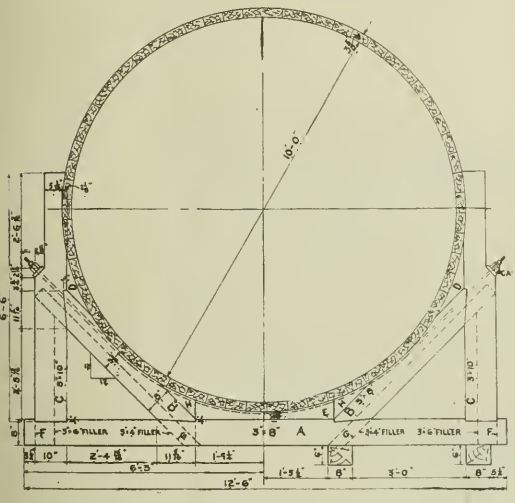


Elevation of Dam at High Falls, on the Mississippi River

gate house, then the grade is 2% for 100 ft., then 4% for 36 ft., and 40% for about 11 ft. at the intake.

The gate house substructure is 27 ft. wide by 30 ft. long and 22 ft. high to the floor of the superstructure. Behind the racks the width tapers to 17 ft. The water section varies from 20 ft. in width by 13 ft. in height to a circular section 10 ft. in diameter, ending in a reinforced concrete elbow which connects with the continuous-wood-stave pipe line leading to the distributor in the power house.

The wood-stave pipe line is 10 ft. inside diameter, approximately 320 ft. long, and is built of British Columbia

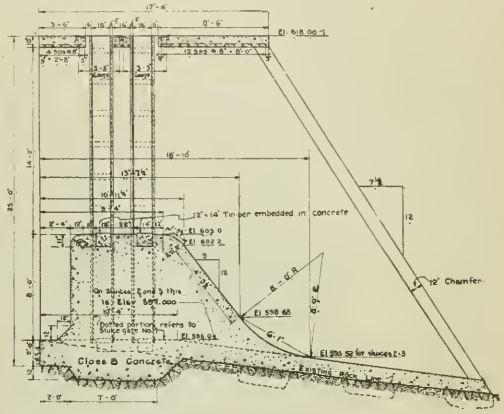


Wood-Stave Pipe, Showing Saddle Details

fir staves 3⅝ ins. thick. It is supported by timber saddles spaced at 6-ft. centres.

The pipe is laid to a 22.4% grade, the difference in elevation between the two ends being about 70 ft. It is banded with 1,025 bands (⅞-in. diameter) of two sections each, these bands being spaced as follows, starting from the gate house: 99 at 7 ins. c. to c.; 79 at 5½ ins.; 91 at 4¾ ins.; 108 at 4 ins.; 123 at 3½ ins.; 144 at 3 ins.; 157 at 2¾ ins.; and 224 at 2½ ins.

The bill of quantities for the pipe line included 2,050 shoes, 62 saddles, 124 saddle rods, 1,030 F.B.M. sills, 124

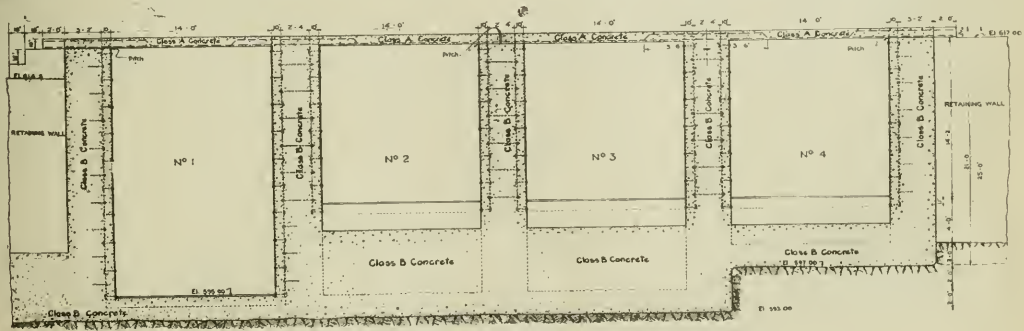


Cross-Section Through Sluiceway

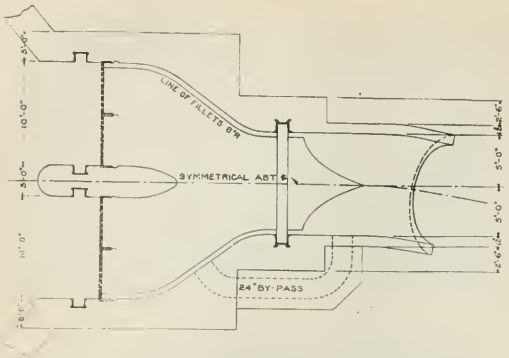
washers and 75 cu. yds. of 2-in. stone for use in bringing rock fill to grade.

The power house is situated on the river bank, and its substructure is approximately 94 ft. long by 62 ft. wide. The greater part of the power house substructure is mass concrete, but the distributor which carries the water from the wood-stave pipe to the turbines, is moulded in reinforced concrete. The turbine casings are steel plate, as are also the draft tubes. The tail water level is 532.5 when the forebay is at 614.0, so the gross head on the plant is 81.5 ft. at high level. The velocity in the pipe line at full load is about 6½ ft. per second.

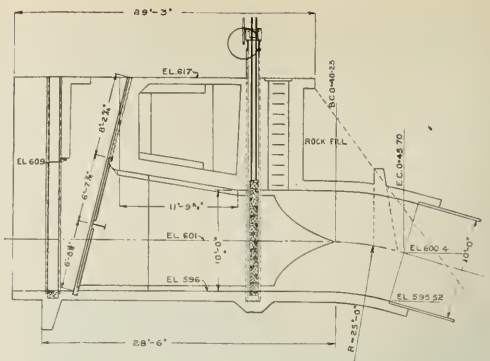
It is of interest to note that the Heath-Edwards surface area method of proportioning materials for concrete was used for the dam, this being the first time that it was used by the "Hydro." According to this system of propor-



Longitudinal Section Through Sluiceways of High Falls Dam



HORIZONTAL SECTION THROUGH GATE HOUSE



VERTICAL SECTION THROUGH GATE HOUSE

tioning, concrete is no longer specified as 1: 2: 4, 1: 3: 6, etc., but is called "Class A," "Class B," and "Class C" concrete. Class B concrete, which was used for the mass work at High Falls, is concrete developing a strength of 2,000 lbs. Class A concrete, which is used with reinforcing, is concrete developing a strength of 2,500 lbs. Test cylinders of Class B concrete taken from the forms at High Falls showed from 2,500 to 2,700 lbs. strength. At first lower results were obtained, but by cutting down the amount of water used and exercising greater care in the proportioning of the materials, the higher strengths were soon secured. Some samples of Class A concrete did not fail at 4,000 lbs., which is the limit of the "Hydro's" machine, so they were held there for three minutes and then tested no further. Crushed stone and gravel were used as aggregate. The stone is a trap of high quality.

Work on the High Falls plant started in October, 1918, and is now about 75% completed. The dam is finished, the gate house partially constructed, the foundations and walls for the power house are poured, the canal has been excavated and the pipe line graded. The pipe has not yet been constructed but the material is on the job, as is also all of the hydraulic and electrical machinery for the power house. The plant will probably "turn over" next spring. It will supply power to the "Hydro's" Rideau system at 23,000 volts, 3-phase, 60 cycles. The construction is being handled throughout by the construction department of the "Hydro." The wood-stave pipe was supplied by the Pacific Coast Pipe Co., Ltd., of Vancouver. The structural steel was fabricated by the Dominion Bridge Co., Ltd., of Toronto and Montreal. The cement used was purchased from the Canada Cement Co., Ltd., and the reinforcing steel from the Steel Co. of Canada, Ltd., of Hamilton

DAM SITE, SHOWING COFFERDAM FOR DIVERSION OF STREAM DURING CONSTRUCTION

Hon. Sir Adam Beck is chairman of the Hydro-Electric Power Commission of Ontario; W. W. Pope, secretary; and Frederick A. Gaby, chief engineer. The design and construction of the High Falls plant, with the exception of the electrical work and the power-house superstructure, are under the direction of the Commission's hydraulic depart-

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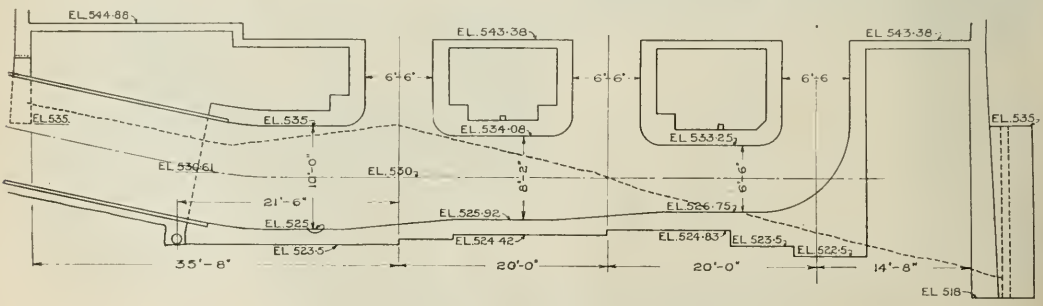

LONGITUDINAL SECTION ALONG CENTRE LINE OF POWER HOUSE

Town Planning, With Special Reference to Ottawa

Planning and Production Go Hand in Hand—The Problems of the Highway and the Railway—Some Notes on the Capital's Present and Future Problems—Address at the Recent Town Planning Conference in Ottawa

By NOULAN CAUCHON
Consulting Engineer and Town Planner, Ottawa

THE principal thing about town planning—at any rate, one of the things that we must bear in mind—is that a city cannot live unto itself any more than can an individual. That is why we have been advocating the benefits of regional planning. The surroundings of a city are what the city depends upon; the city is merely a market of exchange; and transportation is the flux of exchange. By adopting the principle of regional planning we are endeavoring to bring about the intensive cultivation and development of land around the cities, from which the cities derive their supplies.

I want to give some of the principles upon which we carry out town planning—the angle from which we work. Now, in analyzing the town planning problem I divide it primarily into threee main issues: Ethics, economics and art. These are but different manifestations of natural law, of the organic law of life.

Town planning is fundamentally a question of ethics. Ethics are those customs of righteousness which become necessity in the evolution of the race in prevailing against extermination.

Ethics means the conservation of energy—above all, of human energy, the most precious of all. That is the point of view we are taking in Canada; it is the conservation of human energy, the unit of production. All wealth, after all, comes from production; it is based fundamentally upon the efficiency of the unit of production. So we are directing our efforts mainly to that organic law of life, production. We have to abolish the slum and we have to eliminate congestion for that purpose. Town planning is a gospel of social regeneration; we are looking at it altogether as a matter of sociology.

Economics are but the conversion of energy in the maintenance of life—production. Economics are but the laws of nature translated into current terms, usually into dollars and cents as the most convenient common denominator to which things different by nature can be brought to equation and solution. In other words, to engineers I may say in particular, the economics by which we compare everything by dollars and cents is, quite outside of the matter of money, the finest decimal scale that the world has ever had for a common denominator to which you can reduce things, as I have said, to an equation and solution for the conservation of energy. The values of horses differ, the values of farms differ, but when you get down to the decimal scale of dollars and cents you get a relative value for the time being; you get your scale and you get your perspective. That is why you must not think we are always thinking of money when we are giving you economic ideas.

Future Depends Upon Production

Art is simply expression sought—I do not always say, obtained—sought through the properties of mind and of matter, of truth absolute, inherent in the nature of things. Technique is but the tempered tool in master hands.

In the matter of organic planning, we are immediately concerned with two great factors, land and transportation, productivity of the soil and the trade routes. These are the two factors which from time immemorial have influenced the migrations and the evolution and the revolutions of mankind. In other words, our whole hope of going on as a nation must be based upon production; where production fails you get political disintegration such as happened in the Roman Empire, and the city and country go to pieces.

Therefore, to get the finest production and the highest results we must have the highest human unit of efficiency; that is the ethics of the thing, and it is upon that that we found our endeavors in the matter of housing. That is why housing is such a very important thing in the life of the nation. It is not philanthropy; it is not religion; it is just pure ethics. It is a matter of what is due to man as his right; and as a result, the efficiency which that man and his children will attain.

Now, under the head of economics, two of the most important things we have to deal with are under the head of transportation. In other words, before you begin to replan a city, the first thing you have to deal with is the matter of your railway transportation. I have attended a number of conferences on this subject, and I have found that people almost invariably refer to the railway as a necessary evil; as something that you have to put up with. But there is no evil at all about a railway. The railway is a splendid means of transportation, both of people and of freight, at the lowest possible rate. It should seek to follow the line of least resistance, but it is not by any means an evil. I do not say that there are not evils connected with railways; sometimes they are evilly located; sometimes they are mismanaged; but fundamentally the railroad is the sinew of life and is essential to the transportation of the country.

Railways as Decorative Feature

I see no reason why your railway station and your railway facilities should not be as fine a decorative feature of your city as is any other of the functions of life—for it is a function of community life; it is inherently fine and beautiful if you treat it so, if you give it proper expression.

The trouble with the railways in most of our cities in this country is that the railway got there first. In the old days property was not so valuable and the railways went where it was most convenient to go and where it was cheapest to build the road; then the cities grew up around them and eventually there came a condition of congestion.

When you are taking hold of a city and developing it and planning it for the future, you have to ascertain what is the path of least resistance in which you can put that railway, because if it is not in the right place, just to the exact measure that your city is prosperous will there be an inducement, an economic justification, for that railway leaving its bed and going, like a great stream in a deep valley, to the lowest point where the flow will be uninterrupted. The point is, that the more successful and the greater your city becomes, the greater will be the danger of the whole thing being upset because the railway is not in the right place. Town planners can see that a railroad roving around is liable to upset their best laid plans; so you have to get your transportation system settled first and foremost.

Your next problem is that of the arterial highways. By "arterial highway" I am going to refer to highways reaching from the centre of the city clear out into the surrounding country from which the city draws its supplies. We are trying to abolish that hard and fast line between the city and the country, because one merges into the other; it is the proper relation of things.

I am claiming that the arterial highway should be located and developed and maintained on the same principle as the railways, that is, on the principle of the ruling grade. Motor traffic has come to stay.

As I stated in a report which I made a short while ago in connection with the separation of grades in cities, it has been the custom when you come to apply to the Railway Commission for separation of grades, for the railway to state: "Our grade is so and so," 0.5, 0.6 or 1% as the

case may be. "Of course, in the separation of grades with the street you cannot depreciate the railway grade because if you do you affect the haulage capacity of the railway"; and invariably the highway has had to be sacrificed. Now, I maintain that neither the railway grade nor the highway grade should be sacrificed. In the separation of these grades the cost should be proportioned in accordance with the importance of the two; but the fundamental point is that the arterial highway ruling grade is just as important as the railway grade.

More Power on Highways

We have to-day, or we had at the close of the war, about 5,000 locomotives in Canada, which, taken at an average of about 300 h.p. each, means 1,500,000 h.p. We have also 250,000 motor cars on our roads, which, at the low average of 20 h.p., means 5,000,000 h.p. That motor traffic is going to double, treble, quadruple, within our easy knowledge; therefore you will have a horsepower of not 5,000,000, but possibly 50,000,000 in the future.

The highway traffic of Canada and of the United States is going to be a greater factor in connection with our transportation than the railway traffic, because you must recognize that everything that is carried on the railways is first carried over the highways, and an enormous amount of the stuff that is carried over the highways never reaches a railway. So your highway traffic, if you have proper roads, will eventually be greater than your railway traffic and this is a matter which will have to be taken into consideration; you will have to preserve your ruling grades for these highways the same as you do your railway grades.

We have 24,000 level crossings, in Canada, or thereabouts, so we have some work cut out for us to separate these grades. They are not all equally dangerous, but the economic factor is there of separating them and at the same time protecting the grades.

Local vs. Through Highways

There are two classes of roads, the local development and the through highway such as the Toronto and Hamilton highway. We are expecting that the Toronto and Hamilton highway will be carried through for connection between Niagara and Hamilton and then on to Brantford, London, Chatham, Windsor, Detroit and through. But if these roads are to become "through" highways, they must be dealt with on the same principle as the great railways of this country; that is to say, they must go on independent rights of way without any frontage.

I may say, by the way, that some remarks I made with regard to the Toronto and Hamilton highway were taken up wrongly; and in that connection I had to address a letter to one of the highway's commissioners in Toronto. The Toronto and Hamilton highway is the best example of the local development road that can be found anywhere in the country; it is fast becoming a village from one end to the other. Now that very feature of the local development is going to choke the usefulness of that road as a "through" highway. Therefore we shall have to have both; we shall have to have good local highways as well as "through."

Triplication of Service

One of the first things that was proposed in the planning of Ottawa, back in 1909-10, was in connection with these railways that enter the city. As is the case in many cities in the United States and Canada, we had a triplication of services; we had three railways coming into the city, each with an independent entrance. That is absolutely unnecessary. Our national waste is perhaps more in the duplication of terminals than it is in the duplication of main lines, bad as that has been. About 80% of the cost of the land for a railway running, say, from Ottawa to the heart of Montreal, would be in the entrances to the two cities.

If you enter three railroads by three different entrances, you are triplicating not only the service; 160% out of 300% is absolute waste upon which the public have to pay interest. We are just waking up in Canada to the economic fact that the public pays the piper. When the railways come near to the margin where they cannot meet their obligations, the Railway Commission has to come to their assistance by permitting them to raise their rates, and a great part of that increase in rates has been necessitated by the policy of unwarranted duplication in the past. You cannot blame one person more than another. The whole of Canada has been developing during the last 25 or 30 years on a speculative policy, not on an economic policy; and when everybody in the country is speculating, you cannot expect that the government policy will not reflect the policy of the everyday man in the street.

We were building railway lines as fast as we could, stretching out over the country a skeleton system and trusting to the inflow of immigration to fill the vacant spaces. Then came the time when immigration stopped, the war broke out, and we suddenly realized that we were simply discounting the future. So we have to get down to economic methods, and one of the most economic things we can do with a view to reducing railway expenditure is to eliminate the duplication of terminals.

Union Terminals Required Everywhere

In other words, the order of the future is union terminals in all cities, whether those terminals be owned by the railways or by the respective municipalities. That is what we are attempting to do at the present time in Hamilton and in London.

The city of Hamilton, as an outcome of the scheme that has been evolved there, has applied to the Ontario legislature for, and has obtained, a special Act to enable them to build the terminals of the city as a municipal enterprise. I believe that Hamilton is the first city in Canada, possibly the first in America, which has undertaken and is preparing and authorized to assume the responsibility of building terminals as a municipal enterprise. Of course, they will be leased to the railways for operation. They are awaiting the outcome of the Bill which is now before parliament providing for the taking over of the Grand Trunk Railway System; when that is settled, the city will be enabled to deal with the companies whose rails come within the city's bounds.

So far as Ottawa is concerned, the three railroads which now come into the city by three separate routes, the Canadian Northern, the Canadian Pacific and the Grand Trunk, could be joined up 3½ or 4 miles out of the city, on the east, and brought in on a common entrance. They could come down the canal to the central station; a tunnel under the city would clear everything in the way of level crossings; then they could proceed out through the Chaudiere and the industrial section and so out of the city on a common route to the dispersal point 6 or 7 miles west at Britannia. The carrying out of that scheme would mean the elimination of the Grand Trunk line across the heart of the city and out to Britannia.

Eliminating the Railway Barriers

In the plan that was originally proposed, I suggested the elimination of some 21 miles of trackage, and some years afterwards 18 miles of that was adopted by the Ottawa and Hull Federal Plan Commission.

If the Grand Trunk passes to the government, one of the first things we hope they will do in connection with the beautification of Ottawa—not as a city in Ontario, but as the capital of Canada—is to eliminate this cross-town line and thus remove a very serious barrier to the development of the city. In the middle of that line, where it runs for ¾ mile through the heart of the city, there is a hole called the Bank street subway, and if you do not go via Bank street, you have to go round one of the ends of that stretch of line in order to get past. Any further opening of that barrier would cost the city $150,000. Several miles of that line are beyond the present city limits and will constitute a like barrier in the future; so the removal of that line and its conversion into a boulevard, parkway or a great highway, will not only remove a barrier but will also enable the city to avoid spending from $8,000,000 to $15,000,000 in the years to come in the construction of subways or under crossings.

But you cannot under cross in the case of every street; and where you do not, you are discounting your development. As a general principle, of course, we prefer to

elevate the roads in the case of these crossings, but it is purely a matter of circumstances.

Ottawa was not planned at all; like Topsy, it "just grew." The mesh of Ottawa streets is as bad as any you can find; it is a girdiron gone crazy, as may be said of almost every city in America where they have not taken hold of town planning. If we do not get this Grand Trunk right of way we will in time have to build other arterial highways through there; that means that instead of buying from one owner, we shall be buying from 1,500 or 2,000 owners. My advice to my brother town planners is this: Wherever possible see that the city purchases the right of way of any railroad that can be removed like this and takes it for a great highway.

Must Plan to Purpose

In regard to zoning, I maintain that you cannot plan except to purpose; you cannot plan unless you know what you are doing it for. If you are going to plan an industrial section, you want great broad streets, narrow sidewalks and blocks probably 500 ft. square. You have to provide for uninterrupted traffic; when one or two thousand men suddenly come out of a factory, they simply swarm down the road, which is at peak load at certain hours. If you are going to develop a high-class residential district, you want deep lots, broad frontages and boulevards; they can stand the carrying charges of the public improvements. Then, if you want a workman's industrial district, you must follow a certain plan—and here I absolutely agree with Mr. Veiller: I am in favor of small lots and small streets, because workmen's homes cannot stand the carrying charges of a great boulevard.

This is the mistake the Germans made in their town planning. In Berlin they had magnificent boulevards and six-story tenement houses for their workmen. Within limits these were architecturally beautiful; they were fine, costly buildings, and the effort to attain the beautiful was there and also in the broad boulevard. But the result was that these working men had to live in six-story tenement houses to pay the carrying charges, with as many as five courts in these great lots 500 ft. deep. Just before the war, the death rate from tuberculosis in these beautiful tenements was 2½ times as great as the death rate among the children brought up in the gutters of English towns. The explanation is very simple. Families live in two rooms. When the head of the house goes to work in the morning, he is not going to bring the children down and allow them to play where they will be run over by motor cars. The mother has to do the house work, and when the father comes home at night he is too tired and it is too late to take the children down to play. Besides, it is not satisfactory nor sanitary for a family to live in one or two rooms where they sleep, cook, eat, do the washing and everything else.

German statistics with regard to the health of the people are based on information respecting the efficiency of a man for military service at the proper age. Their statistics show that just before the war only 20% of the young men whose parents had been born in Berlin were fit for military service at the military age; and that was due to the condition of living which I have suggested. Moreover, it cannot be said that the German was not an orderly man; he was subjected to military training; he was amenable to rules and regulations with regard to cleanliness. There was never any suggestion that these people were not cleanly; the high death rate among these children was a result of a purely economic condition.

The Technique of Sociology

As I say, city planning is simply the technique of sociology. Regulations as to how high a house should be, as to how wide a house should be, as to how wide a street should be, and as to the distance between buildings—these are simply means of ensuring health; it is simply the technique of sociology, the ensuring to a man of living conditions which will give to him and to his children a degree of efficiency and a state of health that will enable him to go forward instead of backward.

In this planning of Ottawa, then, one of the main features is the grouping of railways and the elimination of certain rights of way and their translation into boulevards. I am going to discuss this matter as impersonally as I can; I do not agree with a good deal that is in the commission's plan.

As can be seen from the plan, a subdivision made up of lots of standard size is set apart, enough for a couple of million people. It is subdivided to the limit of site, in a manner which presupposes 50 by 100 ft. lots, to infinity. That is just the error of the gridiron plan magnified to infinity. You cannot select from it one section and say that that is to be a high-class residential section or a cheap workingmen's section—and when I say "cheap" I do not mean to say cheap in the nasty sense; I mean the securing of the best possible conditions for the very least amount of money. It is simply a question of taking into account a man's wages and allowing 15% for his rent—that factor varies between 10% and 25%—and a certain amount for the land. If the land is expensive, the purchaser may not be able to build his house with due regard to comfort and sanitation. Of course, the man who owns the land will get what he wants, and what is left will build the house—or, as is generally the case, will not build the house—and you get a condition lacking in sanitation and efficiency.

Location of Arterial Highways

I claim, therefore, that you cannot plan unless you know the purpose for which you are planning; that is why I say that the location of the great arterial highways is the next move after you deal with the railway situation. You may say: "We are going to make an industrial section of this part." Well, you may make it on the plan, but if your industrial section is planned on the top of a hill, the people simply will not haul their produce there. It is a fundamental law of nature; it is Newton's law of gravitation. Every ounce lifted and set down costs so much money. Man is also an animal; he likes to do things with the least effort. It is one of the fundamental principles of political economy that a man seeks to accomplish his ends with the least possible effort.

Special Conditions at Ottawa

This Federal District plan embraces Ottawa in the province of Ontario, and Hull in the province of Quebec. It would be very difficult to bring about here such a Federal district as there is at Washington. There are certain things applicable to the conditions in the District of Columbia that are not applicable at Ottawa. There is the fact that this proposed Federal District would embrace two different provinces, each with different laws. The suggestion has been made by some that we might have something like the London County Council—simply community control of physical features and public utilities, the legal twists and kinks being left with the various lawyers to disport with.

It is fundamental that water supply be protected. Many years ago the Ottawa Board of Trade took this matter up, and they asked me to delimit what should be the Federal District. I simply ran my pencil around the watershed and said: "You have to have control of your watershed; otherwise anything you may do for the purification and protection of your water supply may be nullified."

Must Control Water Supply

You have to control your water supply within the area that you are going to govern; otherwise you cannot guarantee sanitary conditions. One of the reasons, therefore, why we want to include both sides of the river in the Federal District is in order that we may secure control of the water supply and prevent the pollution of the river. At present there is noting to prevent the villages above the city—and they do it—from putting sewage into the river. Of course if the villages are far enough above the city, the aeration, etc., may obviate the danger; but this consideration has an important bearing upon the whole matter. It is true that we have legal means to stop it, but if we take steps in that direction, the people below will put us to the expense of building a purification plant. That is the position we are in. It is a case of you scratch my back and I will kick you,—not scratch yours!

(Concluded in next week's issue)

COMMITTEE FOR MONTREAL CONVENTION

JOHN A. KIENLE, secretary of the Water Works Manufacturers' Association, announces that the following have been appointed to serve on the entertainment committee for the next annual convention of the American Water Works Association, which is to be held next June in Montreal, Que:—

H. G. Hunter (chairman), of the New York Continental Jewell Filtration Co., Montreal; G. B. Greene, of the General Supply Co. of Canada, Ltd., Ottawa; T. W. Lesage, of the Montreal Water Works; T. A. Hutchinson, of Drummond, McCall & Co., Montreal; F. C. Laberge, consulting engineer, Montreal; John A. Kienle, of the Electro-Bleaching Gas Co., New York; and James J. Salmond, representing *The Canadian Engineer*.

The objects of the Water Works Manufacturers' Association are: "(a) The advancement of the interests of its members and of the water works associations; (b) the providing for and having custody of such exhibits of materials as may be made at the conventions; (c) the furnishing and distributing of all badges used at conventions; and (d) the establishment of friendly co-operation and relations with its members and with the delegates of the water works associations."

C. B. & C. I. NOW HAS DOMINION CHARTER

IN preparation for the second general conference of the Association of Canadian Building and Construction Industries, to be held January 27th to 30th, inclusive, at Ottawa, the executive of the association has issued a pamphlet briefly reviewing the association's work to date, as follows:—

"1. One meeting of the national council has been held in Toronto, defining the policy of the association, and drafting by-laws.

"2. Several smaller meetings of members of the council have taken place in Montreal, Toronto and Ottawa.

"3. The Montreal Builders' Exchange has been reorganized in accordance with the aims and objects of the Canadian Association, and is now known as 'The Association of Montreal Building and Construction Industries.' It is now organized in three main sections, viz.: general contractors, trade contractors and supply men.

"4. A branch has been organized at Sherbrooke, Que., and affiliation was later secured with the local board of trade.

"5. The contractors of Ottawa held a banquet and organized the Ottawa Branch of the association. A very successful industrial council has been formed.

"6. At a banquet of Toronto builders early this year the question of reorganizing as a Toronto branch was discussed, and the idea approved. No definite action has since been taken, as it was felt that a number of questions should be settled at the next annual conference before final action.

"7. Ever since the last conference in Ottawa the officers of the association have been consulted by the government as representing the building and construction industries of Canada. The government requested the association to send six representatives to the recent industrial conference, and we had a delegate on each of the two most important committees.

"8. We have been building up a connection with the National Federation of Construction Industries of the United States, and have been visited by the president, Ernest A. Trigg, and the secretary, John C. Frazee, who furnished us with valuable information.

"9. A Dominion charter has been obtained, thus giving the association a corporate existence."

The pamphlet also states that it is planned: (a) To invite the affiliation of existing local and provincial bodies; (b) to organize new branches throughout the Dominion; and (c) to promote a closer acquaintance and knowledge of conditions throughout the Canadian building and construction industries by various membership publications.

The association needs about $2,000 to finance requirements until the next conference, when a permanent membership basis will be arranged. Contributions of from $10 to $50 each are being requested by J. Clark Reilly, the acting general secretary.

NOVA SCOTIA POWER COMMISSION

AT the request of the Pictou County Light and Power Committee, a public meeting of the Nova Scotia Power Commission was held November 4th, in New Glasgow, in order that the citizens of Pictou County might have an opportunity of demonstrating to the commission the necessity of some immediate action in connection with the power situation in Pictou County. It was claimed that Pictou County, already a large and industrial community with great possibilities of expansion, is absolutely handicapped in competition with other parts of the country, due to the present high cost of power in that vicinity, even though it is a large coal-mining district.

It was shown that there is at present available a guaranteed market of at least 10,500 h.p., and that the municipality of Pictou County, being free from bonded indebtedness, is ready and willing to undertake the distribution of any power which might be supplied to it in bulk by the Nova Scotia Power Commission, either from hydro-electric or central steam plants.

Hon. Mr. Armstrong, chairman of the commission, assured the meeting that steps would be taken immediately to deal effectively with the situation as presented, and pointed out that although the commission had been in existence only six weeks, it is already prepared to make a definite recommendation to the provincial government and to take immediate action upon receiving the necessary authority in regard to the power situation in the vicinity of Halifax.

The Ontario Section of the American Society of Mechanical Engineers will hold a meeting at 6 p.m. to-morrow evening at the Engineers' Club, Toronto. Supper will be served. This meeting is to enable the members of the section to become better acquainted, and to decide questions of policy regarding the future of the section and the work for the coming winter. Brig.-Gen. C. H. Mitchell will deliver an address. The chairman of the section is Prof. R. W. Angus, and the secretary is C. B. Hamilton, Jr., of the Hamilton Gear and Machine Co., Ltd., Toronto.

Following is the schedule of the short courses in highway engineering at the University of Michigan as announced by Prof. Blanchard: Highway Transport, Prof. Blanchard. Feb. 2 to Feb. 6; Bituminous Surfaces and Bituminous Pavements, Prof. Blanchard, Dec. 1 to 19; Highway Laboratory Research, Prof. Bateman, Jan. 5 to 23; Highway Bridges. Prof. Gram, Feb. 9 to 20; Specifications and Contracts, Prof. Riggs, Feb. 9 to 20; Earth, Gravel and Broken Stone Roads, Prof. Bateman, March 1 to 12; Cement-Concrete Pavements, Prof. Blanchard, March 1 to 9; Brick Pavements, Prof. Blanchard, March 11 to 19; Highway Engineering Seminar, Prof. Blanchard, Dec. 1 to March 19. The fees for courses are from $5 to $15 each.

Morran & Beatty, Ltd., contractors, of Peterborough, Ont., have been awarded the contract for the hydro-electric power development at Grand Falls, on the Nepisiguit river, for supplying power to the Bathurst Lumber Co., of Bathurst, N.B., in connection with their lumber mills and new pulp plant. Two units will be installed, provision being made for a third unit. Each unit will be 4,500 h.p. The turbines will be of the vertical type, direct connected to generators. The turbines will operate under a head of 100 ft. The dam and power house—the former 450 ft. long—will be constructed of concrete. The power will be transmitted for 19 miles; the line will be constructed on steel poles. William Kennedy, Jr., of Montreal, is the hydraulic engineer, and Dr. L. A. Herdt, Montreal, the electrical engineer for the project.

WATER METERS A PROFITABLE INVESTMENT*

By W. H. Randall
Managing Director, Neptune Meter Co., Ltd., Toronto

THE general meter question has been before the public in the United States for some years, but in Canada it is only starting to become a live subject. Those who are closely connected with water distribution, have found that something in the way of a check must be done to offset the waste, due largely to the carelessness of the public, who in many cases allow their plumbing to become defective, and in others, who allow the water to run to waste down the sewer instead of closing the valve or tap after each operation.

This is a common practice in garages and other places where they have cement floors drained to the sewer. The washer drops the hose on to the floor and lets the water run until he is ready to use it again. Thousands of gallons of water are allowed to go to waste daily in this manner.

An important feature has arisen which practically makes it compulsory for every city to consider the selling of water by meter to-day. Filtration plants have become a necessity in practically all parts of Canada, and the pumping and filtering of water, with the cost of labor and the price of coal, is a very expensive proposition for any city. To allow people to use water indiscriminately, without any restriction, in the very near future will be a thing of the past.

Large Cost of Waste

One would at once ask why a man should pay for electricity and gas by meter and be allowed to take water just as he saw fit on a rate based upon the number of rooms in his house. I think that nobody would start a private water company upon any such basis as that.

The per capita daily consumption during the year 1918 in Toronto was 128 Imperial gals. Buffalo, N.Y., used 310 U.S. gals. per capita, while New Orleans, La., used only 64 gals. While we admit that there may be circumstances why cities would differ more or less in their per capita consumption, this should hardly be so great as the difference between Buffalo and New Orleans. Buffalo used about five times as much as New Orleans. Much of this, surely, must have been due to waste.

Scarcely anyone doubts the strong tendency of water meters, as of gas and electric meters, to prevent waste and leakage and to secure careful use. How far meters will accomplish this requires a very careful and exhaustive study.

In the United States, according to census figures, every million gallons of supply of water allowed to run to waste through leaking underground piping and bad plumbing costs a city (for operation and interest charges) $65 a day, or over $23,000 a year.

Flat Rate More Expensive

With our high tax rate and rapid increase in the cost of living, the financial advantages of checking leakage and other waste of water can hardly be exaggerated.

The metering of business properties is agreed to by all. It will surprise most people, however, to know that the average house-owner, as well as the city, gains by the installation of a water meter, and every tenement house owner in Toronto, for example, would gain by having a meter installed. Take an eight-roomed house under the present system of rating in Toronto:—

Eight rooms at 65c.	$ 5.20
Basin or tap in sink	1.25
One bath	1.25
Closet	2.00
Hose	1.00
Pair of laundry tubs	1.25
Total	$11.95

With four persons in the house, and taking a maximum use of 40 gallons a head through the meter, it would figure for the 12 months, 58,400 gallons. This at 13 cents net would only amount to $7.59 per annum by meter, while the flat rate shows $11.95. The minimum rate, however, in Toronto, for meter rent is $2 a quarter-year, which would mean $8 per annum, so a person with a meter in an eight-roomed house would at least save the difference between $11.95 and $8, or $3.95, providing that his plumbing, etc., was kept in proper condition.

From this it can be seen that anyone with a house of eight rooms or more would be better off by having a meter, and would pay for the same in a few years, even if he had to buy the meter himself.

My opinion on this question would be best expressed as follows:—

1. The water supply should be metered.
2. The meters should be purchased and installed by the city at its expense, and not by the property owners, as is often done at present.
3. The city should make all repairs to meters at its own expense.
4. The installation should be spread over five or six years.
5. A minimum rate should be established.

*Excerpt from an address delivered November 6th, 1919, at a meeting of the master plumbers of Toronto.

SWIMMING POOL MANAGEMENT*

By William P. Mason
Professor of Chemistry, Rensselaer Polytechnic Institute, Troy, N.Y.

OF course a swimming pool should be constructed in a satisfactory manner from an engineering standpoint. And it is especially desirable that the means of getting the water out of the pool should be carefully looked into. Several pools that I have had more or less to do with, have their outlets in the side. That is a very serious error. If there be any deposited matter in the pool that is to be gotten rid of, it is practically impossible to draw such sediment through any side orifice without nearly emptying the pool. If the orifice be in the floor, then the material can be pushed on top of the outlet grating and a very few turns of the valve handle in the pipe leading to the sewer will dispose of the sediment without difficulty and with small loss of water. With a pool, the size of ours at Troy, containing 100,000 gallons, unnecessary loss of water quickly runs into money and calls the attention of people who have to pay for it.

I have noticed that the side gutters are sometimes poorly designed. If they extend too far from the wall it is a very serious inconvenience; on the other hand, if they are covered by the overhang the swimmer cannot easily spit into them unless he is a dead shot, and in his efforts to do so he often misses entirely and the sputum gets into the pool, where it proves a most disgusting thing for a bather to swim against.

"Fill and draw" pools are usually filled and emptied about once a week. This type is getting somewhat scarce and water must be pretty cheap in order to allow of such a form of operation. More commonly, the water is continually circulated, as at the Rensselaer Polytechnic, is subjected to some system of improvement, and is replaced after long stated intervals. At Rensselaer we retain the same water for a year, making the change in August. That time is selected because the students are then away, and we can run out the old water, look things over and refill with less inconvenience. Throughout the year the same water is continually circulated by the pumps through the filters, of which we have four, each 4 ft. in diameter. Our rule is to chlorinate once a week with chloride of lime. Where the same water passes constantly through filters using alum, it is necessary to keep watch of the alkalinity and restore it at times with soda ash.

What is to be done in the way of protecting the pool by rules? It is easier to make than to enforce them, and at

*Paper read at the last annual convention of the New England Water Works Association.

times some failures will occur, but on the whole they are not troublesome. So far as disease transmission is concerned, people who are suffering from anything very serious are not likely to ask admission to the pool, and if they do ask admission, it is the watcher's business to keep them out. I believe that there is less trouble in the matter of damaging the pool from specific diseases than people imagine, due very largely to the fact that people who are suffering therefrom do not care about entering the bath, and certainly they do not care to be caught doing so. We do not ask that a man with a slight cold shall refrain from bathing. In some places they do ask that, but it is carrying the protection of the water pretty far. I have no doubt a man with a mild cold can easily get by without being detected and get to the pool if he wants to go.

Temperature, Color and Turbidity

At what temperature is it best to keep the water? At Rensselaer we keep the pool at 76°, except on the occasion of a swimming match of some kind and then we run it down to 72° merely to put a little "pep" into the men who are performing. Under ordinary conditions if one is going in simply for the pleasure of having a dip, or for learning how to swim, anything short of 74° or 76°, makes it a rather strenuous undertaking. In the summertime, a swim in the open is quite different, and one can stand cold water then very well, but with a pool under cover in the winter time, unless the water is up in the seventies, a bath feels uncomfortably chilly. Of course, a Turkish bath is a different proposition; a cool pool is needed under those circumstances in order to start a reaction from the very high temperature to which the bather has been exposed.

High color or turbidity is unsightly and masks such undesirable floating material as sputum, but beyond that either may be absolutely dangerous. I have in mind what happened at one of our large institutions not many years ago. The pool was very turbid and on draining it, a man who had been missing for some days was found at the bottom. Unless the bottom of a pool can be seen, it is better not to use it. A prominent girls' school has recently closed its pool on account of the turbid character of the water. While it was still in use, whenever a group of girls went in, the teacher had to keep watch all the time to see if somebody was missing. A turbid pool is very dangerous and should not be tolerated. A color or turbidity small enough to be possibly unobjectionable in a drinking glass might be sufficient to prevent the bottom of a pool being seen through a depth of eight or nine feet. Partly in this connection, it may be permitted to add that at one of our universitieis a fatality was occasioned by a student diving into an empty pool at night. Such an accident can, of course, be guarded against by suitable rules controlling admission.

Suction Sweeper Removes Fibre

To remove the sediment which collects at the bottom of the pool we use a sweep at Rensselaer and push everything that settles, onto the top of the outlet grating, whence it is flushed to the sewer by suddenly opening the valve. As I have already said, the grating must be on the bottom rather than on the side to allow of this being done.

In pools used by women, bathing suits are worn, usually colored ones, and the amount of fibre that comes off is vastly more than one would think, and it is most unsightly. I saw a device not very long since in Boston, designed to remove such material. It is best described as a modified carpet sweeper of the suction type, entirely similar to what is ordinarily used for cleaning floor rugs. The handle is about one-and one-quarter inches in diameter, and of course it is hollow, and it is attached to a suction motor by a hose. There is a brush at the bottom and about 18 ins. long and 6 or 8 ins. wide, filled with stiff bristles set along a slot. Upon applying suction the material goes out through the handle and is discharged into the side gutter.

Although chlorination and filtration are the usual means employed for keeping the pool water in proper condition, there are two other ways of securing water improvement—ultra-violet light and ozone—which have been somewhat recently introduced. The University of Illinois formerly used chlorination, but they are now using ultra-violet light, and they speak well of it. As a device it is certainly very attractive in appearance. It may be remembered that the Athletic Club at 59th St. and Sixth Ave., New York, uses it successfully, although with what charge for upkeep I cannot say. The Board of Health of New York City has pretty thoroughly threshed out the question of ozone and has reported favorably on it. The amount of money which is quoted in the Board of Health report is small enough, but the upkeep of an ozone plant is usually considerable. It is a fragile thing. And so is the ultra-violet light outfit a fragile thing. We have one in Troy, used for other purposes, and we have found it to be pretty fragile in our experience.

At Rensselaer we attempt to keep our alum dose about one grain per gallon, but, of course, we do not hope to strike that amount accurately, as we employ self-feeders. It is not as though we had a large plant where we could run in a well-controlled alum solution.

So far as chlorination is concerned, we use a very homely, but we think an efficient, method of application; ordinary bleaching powder is mixed up with water into a cream and distributed directly by hand at the shallow of the pool. In dose we use "bleach" enough to correspond to .6 of a part per million of chlorine, which is the amount legally adopted in California. At Yale they use .3; Northwestern .6, the same as we do; and in some other instances the dose is as high as 1 part per million.

Objections to Dosing

We all realize that there is an immense amount of objection on the part of some bathers to the dosing of a pool. We have had complaint time after time, and it is usually based upon imagination. A bather cannot detect the presence of .6 of a part of chlorine per million. In practical tests we found that there was a suggestion of smell at 1½ parts chlorine per million, but no taste and no action on the eyes whatever. At 2½ parts per million of chlorine there was a faint smell, but there was no taste and there was no action on the eyes. When we ran up to 50 parts per million, of course we got a strong taste and we also got a strong smell, but did not notice any action on the eyes. The bathers have complained of dosing when no dose had been used. I remember that years ago when we were about to turn on the alum at the new filter plant at Elmira, the people tasted the alum four days before we put it in.

With reference to establishing a legal standard for the water of swimming pools, I know of only two states that have made the attempt, California and Florida. California has a pretty liberal standard. They attempt to keep the total count of bacteria below 1,000. At Rensselaer we do better than that. It may be rather more good luck than good management, but we have been running on an average of about 250.

So far as the presence of coli is concerned, we rarely get coli, as our .6 of a part per million of chlorine every week seems to control their growth. California allows one bacillus coli communis per cubic centimeter.

The preliminary showers should not be too cold and the soap used should be liquid. Many people dread a cold shower although they do not object to a cool plunge, consequently, unless arrangements are made to take the chill off the shower water, the actual washing accomplished by it will be rather sketchy.

Treatment With Copper Sulphate

Pools that are built in the open without protection from direct sunlight, will probably be troubled with growths of algæ, especially if they be filled with ground water. Copper sulphate is the natural remedy in such a case and the amount required, which is very minute, is best determined by trial. Considerable stress is sometimes laid upon the advantages of direct sunlight in those unusual cases of such indoor pools as possess it, but the gain is offset, at least in part, by liability to algal growths. In such instances copper sulphate is again useful, but the need for complicated apparatus to administer the dose is unnecessary. Plants supplied with such dosing outfits seldom or never employ them.

(Concluded on page 467)

Report on Water Powers of British Columbia

Volume of More Than 650 Pages, by Arthur V. White, Published by the Commission of Conservation—Thoroughly Covers Water Legislation, Meteorological and Topographical Data, Surveys and Maps, Stream Flow Data, Bench Marks, Power Sites, Present and Proposed Developments, Electrical Inspection and Bibliography

COMPRISING 610 pages (6¾ by 9¾ ins.) of text, 36 pages of half-tone illustrations, 10 pages of line diagrams, 3 maps and 24 pages of index, the volume, "Water Powers of British Columbia," just issued by the Commission of Conservation, forms a substantial and noteworthy contribution to Canadian civil engineering literature. The volume was written by Arthur V. White, consulting engineer to the Commission, assisted by Charles J. Vick.

The field work necessary to secure the data for the volume was started in 1911, with the assistance of the British Columbia government, but circumstances connected with the war delayed the publication of the report. It is now ready for gratuitous distribution, however; engineers and others interested in the subject should apply at once for copies, as the edition is limited. A small number of copies have been bound in cloth, but the greater portion of the edition is paper-bound.

The book is divided into 18 chapters, as follows:—

1. General introductory survey (30 pages).
2. Water power data (16 pages).
3. Historical survey of water legislation in British Columbia, with chronological key (66 pages).
4. Certificates of approval; orders in council; rules, regulations and fees (18 pages).
5. Electrical inspection by province of British Columbia; table of power plants (10 pages).
6. Electrical inspection by Dominion of Canada; exportation of electricity (9 pages).
7. Power developments in British Columbia; brief description of the chief developed water powers from the physical standpoint; some proposed power developments; brief reference to a few undeveloped water powers which have been specially investigated (27 pages).
8. Surveys and maps of British Columbia, including a reference to range of tidal levels (15 pages).
9. General topography of British Columbia (5 pages).
10. Columbia river and tributaries; topography; power site tables (32 pages).
11. Fraser river and tributaries; topography; power site tables (29 pages).
12. Vancouver Island; topography; power site tables (9 pages).
13. Mainland Pacific coast; topography; power site tables (31 pages).
14. Mackenzie river and tributaries; topography; power site tables (8 pages).
15. Stream flow data; gauging stations in British Columbia; historical reference to inauguration of stream flow study in province; description of stream flow data included in this volume; index to published stream flow data; tables of stream flow data; miscellaneous discharge measurements (158 pages).
16. Stream flow data; certain gauging stations in United States; reference to gathering of stream flow data in United States; index to published stream flow data on international streams; tables of stream flow data (22 pages).
17. Diagrams showing the distribution of precipitation, temperature and run-off in British Columbia; explanatory statement (17 pages).
18. Meteorological data; introductory statement; list of precipitation stations in British Columbia and selected stations in Alberta and Yukon; precipitation records for stations in British Columbia and selected stations in Alberta and Yukon; list of selected precipitation stations in United States on international watersheds or adjacent to British Columbia; monthly and annual mean precipitation at selected stations in United States; temperature records for selected stations in British Columbia; monthly and annual mean temperature at selected stations in United States (85 pages).

Appendices: (a) Hydraulic conversion tables and convenient equivalents, with statement respecting the "miner's inch" (10 pages); (b) list of certain bench marks on Vancouver Island and Pacific mainland coasts (4 pages); (c) bibliography (19 pages); and (d) index (24 pages).

A two-page, two-color physiographic map of British Columbia is bound in with Chapter 9, "General Topography of British Columbia," while two large three-color maps, "Water Powers in British Columbia," and "Precipitation Stations in British Columbia and Portions of Yukon, Alberta and United States," are folded and inserted in a pocket in the cover. The various power sites and precipitation stations indicated on the maps are so numbered as to afford rapid and easy reference from the maps to the corresponding description in the text, or vice versa.

STREAM ON PRINCESS ROYAL ISLAND

A typical steep descent from lake in "hanging valley," as frequently found along the fjords of the British Columbia coast.

1. Introductory Survey

Chapter 1 reviews the general objects of the report and discusses various phases of the subject under such headings as the influence of forests upon run-off; the relation of water to agriculture; the relation of water power to irrigation; the interdependence between water power and navigation; the serious interrelationship between inland fisheries and the dams and other structures required for water-power development; the relation of the inland waters to mining and to the tourist traffic; the possible effect upon international relationships, etc. Concluding this discussion, the author summarizes it as follows:—

"First, we have observed that precipitation is the prime source of inland water supply, and that not only water power, but such other interests as domestic and municipal water supply, agriculture, irrigation, navigation, fisheries, mining and riparian rights, are all dependent upon the same source. Consequently, water should not be allotted for power development without due recognition to the just demands of other interests having claims upon our inland waters viewed broadly as a natural resource.

"Second, run-off, manifested in the form of stream flow, is intimately associated with the character of the ground

upon which precipitation falls, and, consequently, care should be taken to conserve vegetal cover; more especially is this necessary for rocky areas which have but scanty soil covering.

"Third, subsoil waters are by no means inexhaustible. Plant growth is dependent upon having available an adequate amount of soil moisture. Nothing should be done to deplete, unduly, the ground-water storage. Effective legislation and administration should be provided governing the tapping of underground water supplies.

"Fourth, the use of water for irrigation tends materially to increase the permanent settlement of the country. Consequently, in most instances, when irrigation requirements and power requirements conflict, the former are entitled to precedence. Hydro-electric power developed on somewhat distant streams may, by means of high tension transmission, be used for pumping water supplies where such are not available by gravity, and may thus facilitate irrigation development.

"Fifth, not infrequently navigation interests are regarded as of much greater importance than power development. Any works contemplated for the improvement of navigation should be considered in their relationship to river systems as a whole. Expenditures should be carefully watched and precautions taken to ensure that improvements, so called, are not undertaken ostensibly for navigation, when in reality they are sought for the sake of such water-power benefits as may incidentally be developed thereby.

"Sixth, the fishing industry in British Columbia is one which demands that the best possible methods be used for its conservation. Provision requires to be made for the upward migration of adult salmon for spawning purposes, and the downward passage of the young fish to the sea. Obstructions, such as dams, rock slides, log jams, etc., may have a disastrous effect upon this industry. Fishways should be provided. The whole question of fishways requires thorough investigation. Other fish besides salmon require conservation. It is not established that satisfactory means have been devised by which fish may successfully ascend over high dams—even over dams which do not exceed twenty to thirty feet in height.

"Seventh, the development of the mining industry during recent years has resulted largely through electrical energy being available through the development of provincial water powers, and the future offers bright prospects for the further application of hydro-electric power to the various branches of this industry.

"Eighth, the pollution of inland waters must be jealously guarded against. Mining, factory and industrial wastes and sewage must not be permitted to foul inland waters. Debris and other waste resulting from logging operations are apt to cause serious log jams, which are a menace to public highways, bridges and also to power development.

"Ninth, the tourist traffic is a valuable provincial asset, not only because of the money actually spent by travellers, but because of the opportunity afforded of drawing attention to the various natural resources of the province. Consequently, every reasonable care should be taken to guard against the spoiling of shorelands through submergence; and further, care should be exercised in the design and construction of power works, making them, where possible monize with the general natural features of their surroundings.

"Tenth, in connection with the use of boundary waters, problems, from time to time, may arise necessitating consideration by the International Joint Commission. In this connection, therefore, it is especially desirable that physical data appertaining to such waters should be so collected as to be available for use in connection with such problems as may arise respecting waters which are classed in the Boundary Waters Treaty as boundary waters."

2. Water-Power Data

Chapter 2 states that "one of the chief objects in securing and publishing data respecting water powers, is to enable the owners of rights to determine the possibilities and limitations of their powers and thus arrive at sound judgment respecting their possible uses and value. Another object is to enable prospective promoters to learn the general possibilities of various powers without the necessity of making costly independent, preliminary surveys. Certainly, if the Crown be the owner of water powers, it is of the utmost importance that it be informed beforehand upon essential facts connected with its water resources."

This chapter cautions investors against proceeding with developments without sufficient knowledge of physical and economic governing factors. The author cites a number of cases in the United States where financial losses have resulted from power developments. The summary of this chapter is as follows:—

"First—Governments have been bestowing increasing attention upon the investigation of inland water resources and, during recent years, Canada has made great advancement in this work. Such work is essential in order to acquaint interested parties with the possibilities of the powers with which they may be dealing.

"Second—A number of factors, such as character of use, uniformity of flow, the making of but partial development in a manner prejudicial to future complete utilization, failure rightly to differentiate between primary power and secondary power, etc., have been noted and attention drawn to the necessity for reckoning with such factors.

"Third—Hydrometric data extending over a sufficient period of time should be available, and conclusions involving important procedure should not be predicated upon scattered and insufficient records. Topographic maps should also be available.

"Fourth—Those interested from the standpoint of the investor may, by the expenditure of ordinary effort, place themselves in a position, independently, to check and form a judgment respecting some of the basic engineering factors involved in any power project under consideration.

"Fifth—Failure rightly to assemble or interpret essential physical data, has been responsible for many serious failures, and has resulted in great financial loss.

"Sixth—No reliance should be placed upon general statements setting forth the existence of vast undeveloped water powers. The total amount of water power capable of economic development is much less than popularly assumed and most of the valuable sites are already under development or control by various interests. Attention has been directed to the concentration of control of water powers as proceeding rapidly in the United States, and the need has been pointed out that those interested in the conservation of our water powers should be alert to see that the same menace to public welfare does not operate in Canada. Much of this concentration of control has taken place during a time when general statements representing the existence of large reserves of potential water power were being presented to the attention of the public and were receiving general acceptance.

"Seventh—The importance of storage has been pointed out, and the possibilities of storage causing damage to riparian owners has been emphasized. Government provision for a flowage easement along the shores of lakes and rivers, would to some extent protect settlers against loss, and would protect the government itself against claims for damage by overflow."

3. Water Legislation

British Columbia possesses one of the most comprehensive water codes in the world. This code has been a gradual evolution from the mining regulations, growing out of the first mining activities in the province. The whole water law of the province is reviewed in Chapter 3, where more than 80 separate enactments have been carefully analysed in order to show their contribution to the water code as it today exists.

The present law deals with the utilization of water for mining, municipal and industrial purposes; irrigation; lumbering operations; water power; and many other purposes. British Columbia is the owner of the water in its inland streams and lakes. This water is leased, under certain conditions of rental, etc., for a term of years. The present provincial Water Act is a voluminous document of some 300 sections. It is a noteworthy measure and vests in the gov-

ernment, by statutory laws, the absolute control of the inland waters of the province. It is not possible to obtain an adequate understanding of the water laws of British Columbia as they are at present, without knowledge of the various individual parts of separate Acts which constitute component parts of the consolidated laws. To supply such knowledge is the aim of this chapter on water legislation. The author reviews the various governmental water measures, so far as possible, in chronological order.

4. Certificates of Approval

In Chapter 4 further information is given regarding the procedure for obtaining a water license, certificates of approval, fees, the making of surveys, etc. A 5-page table gives a list of the certificates of approval and orders-in-council that have been issued to date relating to the diversion of water for power and other purposes. This table gives the name of the grantee in each case, the name of the stream affected, the date of approval, the date and page of publication in the British Columbia Gazette, and remarks indicating the nature of the undertaking that was approved.

5. Electrical Inspection by Province

In Chapter 5 the author shows what steps have been taken to protect the public from accidents arising from the increased use of electrical energy, how companies are protected from unjust claims made by injured parties, and how companies are protected from undue pressure by municipalities. The chapter concludes with a list of the principal equipments of power developments in British Columbia which come within the jurisdiction of the Electrical Energy Inspection Act.

6. Electrical Inspection by Dominion

Chapter 6 deals with the subject of electrical inspection by the Domonion of Canada, chiefly in its bearing upon the exportation of electricity. Commencing with the British North America Act of 1867, the author traces the history of events leading up to the Electrical Inspection Act and to the Electricity and Fluid Exportation Act. There is supplied a list of electric light and power installations in British Columbia falling under Dominion jurisdiction.

RAPIDS ON THOMLINSON CREEK, A TRIBUTARY OF THE TOBA RIVER
A typical coast stream, descending over 600 ft. in 4 miles.

7. Power Developments

In addition to the table of "Power Plants in British Columbia," given in Chapter 5, there are specially described in Chapter 7 twenty of the more important hydraulic developments in the province.

There is in all about 300,000 h.p. at present developed by water power in British Columbia. The aggregate capacity of the installed prime movers is also about this amount, of which 152,000 h.p., or about 50%, is installed at the various plants of the British Columbia Electric Railway Co. and the Western Power Co., to supply the needs of Vancouver and Victoria and surrounding districts, including various municipalities in the Fraser river delta.

Another important power-using district is that supplied chiefly by the two plants of the West Kootenay Power & Light Co. at the Bonnington falls on the Kootenay river —namely, the boundary district lying to the south and west of Nelson. The total hydraulic installation in this district is about 50,000 h.p., used chiefly for the mining industry.

Of the larger developments for industrial purposes, about 50,000 h.p. is installed for pulp and paper manufacture, and approximately 40,000 h.p. for mining, in addition to the 40,000 h.p. developed by the West Kootenay Power and Light Co. and used chiefly for mining and smelting purposes.

It is interesting to note that a large development of water power has been found profitable at the mines of the Canadian Collieries, Ltd., on Vancouver Island, where coal is available at pit-head cost. There are about twenty water-

TETACHUCK FALLS, BELOW OUTLET OF TETACHUCK LAKE
This picturesque fall on the upper waters of the Nechako River is typical of undeveloped power sites in the interior of British Columbia.

power developments in British Columbia, in which the installed capacity in each case exceeds 1,000 h.p. These are as follows:—

PRINCIPAL WATER-POWER DEVELOPMENTS IN BRITISH COLUMBIA

Development.	Installed h.p.	
British Columbia Electric Railway Co.		
Coquitlam-Buntzen power house No. 1	43,500	
" " " " " 2	40,500	
Esquimalt reservoir plant	4,200	
Jordan river plant	25,000	
		113,200
West Kootenay Power & Light Co.		
Lower Bonnington falls	4,050	
Upper " "	34,000	
Cascade plant on Kettle river	3,900	
		41,950
Western Power Co. of Canada, Stave falls plant		39,000
Powell River Co., plant on Powell river		24,000
Pacific Mills, Ltd., plant at Ocean falls		21,100
Britannia Mining & Smelting Co., plants at Britannia Beach		12,640
Canadian Collieries (Dunsmuir), Ltd., plant on Puntledge river		12,000
Granby Consolidated Mining, Smelting & Power Co., plant on Falls creek		6,600
Whalen Pulp and Paper Mills, Ltd.		
Plants on Mill and Cedar creeks	4,000	
Plant at Swanson Bay	2,500	
		6,500
Nelson City, Upper Bonnington falls		3,400
Hedley Gold Mining Co., plants on Hedley creek and Similkameen river		2,600
Revelstoke City, plant on Illecillewaet river		2,550
Kamloops City, plant on Barriere river		2,400
Prince Rupert City, plant at Woodworth lake		1,650
Surf Inlet Power Co., plant at Surf Inlet, Princess Royal Island		1,260
Granby Mining, Smelting & Power Co., plant on Granby river		1,040
		291,890

In this chapter are also brief descriptions of a few of the large undeveloped powers which have been the subject of special investigation and for which developments are proposed. These include the following:—

Diversion of Bridge river to Seton lake, 1,200 ft. head, 100,000 h.p.; Campbell river, head 125 to 450 ft., depending upon scheme adopted, 100,000 h.p.; Shuswap river, 130 ft. head, 12,000 h.p.; Jones lake diversion to Fraser river, 1,800 ft. head, 25,000 h.p.; Indian (Mesliloet) river, heads about 1,900 ft. and 450 ft. (group development), about 10,000 h.p.; Falls river, 245 ft. head, 16,000 h.p.; Khatada River, 350 ft. head, 10,500 h.p.

8. Surveys and Maps

Chapter 8 is devoted to surveys and maps. To the engineer who requires to assemble data basic to the consideration of any water-power project in British Columbia, it will be a grateful aid to find at hand this classified analysis of the various surveys and maps relating to the province. There is a complete list of maps relating to British Columbia published by the Geological Survey of Canada, the Department of the Interior, the British Columbia Department of Lands and the Admiralty. In almost every case there are given the number of the map, the title, the scale, the price if any, the year of issue, and the approximate size of the map.

9—14. Topography and Power-Site Tables

Beginning in 1911 in the southerly part of the province, the Commission of Conservation inaugurated its reconnaissance water-power survey of British Columbia. In addition to the results obtained by direct field operations, information respecting water-power possibilities of the provincial streams was gathered from exploratory and other reports, from individuals, from corporations and from governmental sources. This information has been assembled and condensed into tabulated power-site tables, which are set forth, together with explanatory notes and topographical information, in Chapters 9 to 14, inclusive.

For the purpose of convenient reference, the province was divided into five districts corresponding in the main to the chief drainage areas. These are: (1) Columbia river and tributaries; (2) Fraser river and tributaries; (3) Vancouver Island; (4) mainland Pacific coast and adjacent islands except Vancouver Island; and (5) tributaries to the Mackenzie river.

The general topography of the whole province is broadly and clearly described in Chapter 9. With the aid of the physiographic map that accompanies that chapter, one obtains a comprehensive understanding of the chief topographical features, especially of the various mountain systems which modify the climate, and influence precipitation and stream flow. The power possibilities of the five districts above mentioned are then dealt with in order, a chapter being devoted to each district. In each chapter the power-site tables are introduced by a description of the topography of the district, supplemented where necessary by brief notes descriptive of the chief tributaries and their respective watersheds.

Preceding the first group of power-site tables is a description which explains their scope and limitations. In the tables the streams are tabulated in ascending order. The power sites are numbered, those on the main streams being first given, followed by the tributaries taken in their respective order as each main stream is ascended. This arrangement permits easy reference both from the tables to the index map and from the map to the tables.

In the tables one finds the name of the stream and site; the watershed area (in square miles) as derived from the latest map or estimated from special survey data; the head (in feet); the estimated horsepower; and remarks respecting the characteristics of the site, such as the character of the fall, gradient of the rapids, the nature of the stream bed and banks, the possibilities for storage, the practicability of dam construction, etc.

The estimates of horsepower are said to be conservative. They are, for the most part, on a 24-hour basis at 80% efficiency and for an ordinary low-water month. Where storage sites are definitely known, weight has been given to this possibility in making the estimates. It is pointed out, however, that owing to lack of precise information the storage possibilities yet to be discovered will be an important factor in increasing the power.

In round numbers, the horsepower totals derivable from the various estimates presented in the power-site tables are as follows:—

		24-hr. h.p.
1.	Columbia river and tributaries north of the international boundary. This comprises the portion of the province lying between its eastern boundary and the watershed of the Fraser river	610,000
2.	Fraser river and tributaries. This includes practically the entire area of the great interior plateau	740,000
3.	Vancouver Island	270,000
4.	Mainland Pacific Coast and adjacent islands, except Vancouver Island. This includes all the rivers north of the Fraser which drain into the Pacific	630,000
5.	Mackenzie river tributaries. A rough estimate made for inclusion in this summary	250,000
	Total	2,500,000

Statements made show that there are about 500,000 h.p. which, at least for many years to come, can hardly be economically developed because interference with the fishing industry or the proximity of railways renders development impracticable. There are also some other qualifying statements applicable to portions of the power tables, but in round figures the grand total of estimated 24-hr. power, in-

cluding an allowance for storage possibilities, has been placed at about 3,000,000 h.p.

With regard to this total estimated horsepower, it is emphasized that "grand totals purporting to represent horsepower possibilities for large sections of a country, are apt to be very misleading. They are especially misleading when used to make comparisons with other totals when, as a matter of fact, no real basis for comparison has been established. The unique character of many of the water-power possibilities of British Columbia, with its exceptional physical features, such as mountain systems, glaciers, snowfields, and widely variant precipitation, necessarily makes it difficult to effect comparisons between the total water-power possibilities of this province and those of other areas differing markedly in physical characteristics."

The engineers who chiefly assisted in the field work from which the above-mentioned data were compiled were G. H. Ferguson, C. J. Vick, D. C. Jennings, C. C. Lyall, A. W. Campbell, L. G. Mills, T. G. Bird, R. Westover, W. A. Wand, F. R. Macdonald, B. Corbould, B. N. Simpson and C. C. Cowan; also A. J. McPherson, who was attached to one of the field parties in 1913 as representative of the Provincial Water Rights Branch. On account of the topography of the province and the difficulty of reaching some portions of it, the work of many of the field engineers was arduous and hazardous and evidently also required a high degree of ability and judgment.

15—18. Stream Flow and Meteorological Data

Stream flow and meteorological data occupy Chapters 15 to 18 inclusive. This collection of records furnishes the engineer with data which would take him much time and effort to assemble independently. Much of the stream flow data is gathered from the Water Resources Papers issued by the Water Power Branch of the Department of the Interior, and due credit is given to that department for same, but other sources of information have also been used and receive credit, many of the records having not hitherto been published.

Chapter 15 contains the stream flow data available for British Columbia, while Chapter 16 supplies similar data for a number of stations in the neighboring states of Washington, Idaho and Montana, on such streams as the Columbia, Pend-d'Oreille, Kootenay and other rivers of an international character. The records have apparently been selected with special reference to their serviceability for water-power development, as some streams serviceable only for irrigation purposes have not been included.

The records are arranged in alphabetical order, and each one is introduced with a brief description of characteristics appertaining to it. To assist in quickly turning to the more detailed records, which include gauge heights, etc., there is an index to stream flow data elsewhere published.

In the meteorological data there is very complete tabulation of precipitation records for all stations in British Columbia, including monthly and annual total precipitation, and, where length of record warrants, the mean monthly and mean annual precipitation (Chapter 18). A summary of snowfall record is also given. Meteorological data is also supplied from portions of Alberta, Yukon, Alaska, Washington, Idaho and Montana, where such data is specially pertinent to some of the watersheds of British Columbia.

In order to convey an understanding of the general trend of meteorological and hydrological phenomena as revealed by the precipitation, temperature and stream flow records, a number of special diagrams (Chapter 17) summarize these data.

An inspection of these diagrams reveals the manner in which the outstanding physical features of British Columbia modify the climate and precipitation in various parts of the province. Due to the great mountain barrier formed by the coast mountains, British Columbia is climatically divided broadly into two main divisions: The Pacific littoral, west of the summit of this range; and the interior, to the east. The other great mountain systems, the Columbia system and the Rocky mountains, modify the climate of the interior and to some extent reproduce the contrasting phenomena as found on the western and eastern side of the coast range in so far as precipitation is concerned. It is, however, the coast mountains that constitute the dominating influence and that control the climate of the interior. The diagrams demonstrate that the Pacific littoral is a region of great precipitation, especially in the winter months. It is characterized, moreover, by a mild and equitable climate, while the run-off from the streams is heavy; and where fed by glaciers, the run-off is well distributed throughout the year.

In the interior the precipitation, except on the western slopes of the eastern mountain systems, is relatively small, the yearly temperature has a much greater range, and the run-off of the streams exhibit different phenomena. All streams in the interior reach their maximum discharge for the year in the earlier summer months and have lowest water conditions in January and February. On the coast the low water is usually at the end of the summer, in August and September, and the maximum floods obtain at the time of the autumn rains in November, although a second peak flood occurs in the early summer on those streams fed in part from glaciers and elevated snowfields.

The influence upon run-off of latitude, elevation, storage and other factors is also shown by the diagrams.

Bibliography

The volume concludes with handy hydraulic conversion tables, a list of certain bench marks, and an extensive bibliography which will be valuable in studies concerning the development of agricultural areas, mining industry, timber industry and fisheries as well as of other provincial resources. In greater or less degree these various branches of activity have been linked up with and are dependent upon the beneficial utilization of inland waters.

About 230 publications are described, some having special explanatory notes. They are classified under the following broad subject headings:—(1) General reference works; (2) Guides, handbooks and other publications giving descriptive information and historical data relating to various natural resources of the province; (3) government and other publications containing descriptions of the physical characteristics of various watersheds; (4) travel and exploration, mountaineering and other sport; (5) works of historical interest, including northwest coast voyages, Hudson Bay Co. affairs, international waters, boundaries and treaties.

In the case of references to the publications of such organizations as the Geological Survey of Canada, the Royal Society of Canada, the Royal Geographical Society of Great Britain, etc., the bibliography quotes "chapter and verse" for such data as have direct bearing upon the natural resources of British Columbia.

The Turbine Equipment Co., Ltd., have moved their offices to the Dack Bldg., 73 King St. W., Toronto. R. M. Austin, manager of the company, is the Canadian representative for Ontario and Western Canada of the De Laval Steam Turbine Co., of Trenton, N.J.

The following Canadians have been invited by the General Electric Co. to inspect a new 265-ton, 3,000-volt, direct-current, gearless electric passenger locomotive which the company has constructed for the Chicago, Milwaukee & St. Paul Ry., and which is now being exhibited at Erie, Pa.: J. A. Shaw and W. H. Winterford, of the Canadian Pacific Railway; C. B. Walker and C. P. Price, of the Canadian National Railways; J. G. Baukat and W. G. Hewson, of the Hydro-Electric Power Commission of Ontario; S. B. Clement, chief engineer, Temiskaming and Northern Ontario Railway; and representatives of the Canadian General Electric Co., Ltd. At the company's test track at Erie, Pa., a speed of 65 mi. per hr. has been obtained and the tests indicate that the locomotive will operate at much higher speed, but that is the limit permissible on the test track. For continuous operation the locomotive is designed to exert 42,000 lbs. tractive effort at a speed of 25 mi. per hr.

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WATER POWERS OF BRITISH COLUMBIA

IN 1910 the Commission of Conservation undertook an inventory of the water power resources of Canada. As a result, in 1911 the Commission's first report on this subject was printed, "The Water Powers of Canada," covering in summary form the information then available for Ontario, Quebec, and the Maritime Provinces. In 1916 a second volume appeared, "The Water Powers of Manitoba, Saskatchewan and Alberta." The report on British Columbia, which was being compiled under the direction of Arthur V White, consulting engineer to the Commission, was delayed by circumstances owing to the war, and has just been issued, completing the Commission's series of reports on this great natural resource.

The volume just issued is more than a report on the water powers of British Columbia; it is also a valuable textbook and an interesting account of all the factors that must be considered in connection with the utilization of water resources. It is written in Mr. White's usual forceful, lucid and logical style, and covers thoroughly all cognate phases of the subject under investigation. Not only is it comprehensive but also compact, no space being wasted despite the large number of pages in the volume. In illustrations, topography and general arrangement, the volume leaves nothing to be desired, and both text and tables bear evidence of painstaking care.

Advantage was sensibly taken by Mr. White of all existing information upon the subject, and of all contemporaneous work done by federal and provincial departments as well as by private companies. Naturally, therefore, some of the data contained in the present report is to be found in other previous publications, notably (so far as the stream-flow data are concerned) in the Water Resources papers of the Water Power Branch, Department of the Interior, but full credit is given to all such sources of information. By making use of others' records wherever they could be obtained and were deemed reliable, Mr. White avoided duplication of effort and saved money for the Commission and for the province, which co-operated in financing the report. Nowhere else has so much data pertinent to the water resources of British Columbia been brought within the compass of one book and so well summarized and correlated. In gathering his own field data, Mr. White had several parties of engineers engaged for a considerable period, and these men had many obstacles to overcome in performing their work, owing to the rough and mountainous sections covered.

The paucity of information concerning British Columbia's water powers existing when the Commission undertook its inventory, is well expressed in the British Columbia Year Book for 1911, which states: "Speaking generally, there is no field of economic interest in connection with the exploitation of the provincial resources respecting which there is less known than the extent to which our water powers may be rendered available." Any person reviewing Mr. White's report will readily perceive how radically different is the present status of British Columbia with regard to knowledge of water resources as contrasted with the status in 1911.

The engineer who has to deal with water power projects will be gratified to find such a complete assemblage of physical data as are presented in tabular form in various parts of the report. These include tables giving the estimated possibilities of water power sites throughout the province, which lists are based chiefly upon results obtained from the special field investigations conducted by the Commission of Conservation. There are also extensive digests of stream-flow, meteorological and other hydrometric records.

The report estimates that a total of 3,000,000 h.p. (24-hour power) is available in British Columbia, and states that "the conditions affecting powers in the province are unique, and do not closely correspond to those existent in other portions of Canada. This is especially true of the mainland Pacific coast. One cannot but be impressed with the fact that coastal water powers in British Columbia, which to the casual observer appear to be of comparatively small amount, nevertheless, may, when economically and fully developed, yield several-fold the estimate of power if appraised upon the same basis as similar streams in Eastern Canada. Glaciers, snow-fields, and heavy rainfall abound, and, with many storage possibilities, constitute unique factors which contribute to enhance the values of powers."

A study of the "Remarks" column of the power-site tables, and of comments throughout the report, reveals the diversified uses to which hydro-electric power in British Columbia has already been applied. The report is replete with references to the extensive and varied natural resources of the province. When one considers the mining, agricultural, lumbering, fishing, navigation and other activities, it is evident how great are the future possibilities for increased utilization and conservation of British Columbia's inland waters, and especially of the power derivable therefrom. In such development *The Canadian Engineer* believes that Mr. White's report will not disappoint the aim of the Commission of Conservation in providing a valuable compendium of data upon this subject.

INTER-PROFESSIONAL CONFERENCE AT DETROIT

WITH the purpose of bringing together the professional men of the United States in order to plan more effective relations and to act together on matters pertaining to the public good, an Inter-professional Conference is being called to meet in Detroit November 28th and 29th. The conference was suggested by the Post-War Committee of the American Institute of Architects, which was established to study the new obligations thrust upon the architectural profession by the war.

It is the hope of those fostering the movement to perpetuate to an appreciable degree the enthusiasm of the war-time service rendered to the public by the professional men. The subjects which are to be taken under consideration have been classified under three heads:—The functions and inter-

relations of professional organizations; relations of professions to the public; and educational obligations of the professions. Representatives of the medical, legal, and engineering professions have accepted membership on the organizing committee.

HYDRO-ELECTRIC POWER DEVELOPMENT AT HIGH FALLS

(Continued from page 454)

ment, of which Henry G. Acres is the hydraulic engineer; Thos. H. Hogg, assistant hydraulic engineer; and Max V. Sauer, designing engineer. E. T. Brandon is the electrical engineer of the Commission; and Arthur H. Hull, assistant electrical engineer. The resident engineer at High Falls is A. L. Malcolm. E. V. Trimble, engineer of the Commission's construction department, is represented on the work by E. F. Lynn.

SWIMMING POOL MANAGEMENT

(Continued from page 460)

Referring again to outdoor pools, it is unfortunate that some cities, even large ones, are not sufficiently careful to select suitable sites for their public baths. When a city goes so far as to fence off and equip some portion of a river or bay, setting aside the same as a public bathing place, the bathers have a right to assume that the site has been selected with care and that the water is hygienically safe, but sometimes the assumption is distinctly risky. In one instance a great metropolitan sewer emptied on the upstream side of a public bath (now closed), and so near that when the sewage was colored by a red dye, the bathers were startled by the bloodlike tint of the bath water.

It is vain to hope that high bacterial counts and the presence of "gas formers" can always be avoided. The human animal is not quite clean enough to insure that, but, nevertheless, it is entirely feasible so to run a public swimming pool as to keep its appearance attractive and its use within what may be termed "proper and reasonable risk."

PERSONALS

F. S. Lazier, resident engineer of Section 2, Welland Canal, has been elected president of the Engineers' Club of Thorold.

Maj. J. C. Johnstone, Maj. J. R. Cosgrove, Frank H. Allwood and J. E. Milne are being considered by the Saanich, B.C., council for the position of municipal engineer.

G. H. Duggan, president of the Dominion Bridge Co., Ltd., Montreal, has been elected chairman of the newly appointed Quebec Division of the Canadian Manufacturers' Association.

Fred J. Matthews has opened an office at 33 Richmond St. W., Toronto, as sales representative of the H. H. Robertson Co., Ltd., of Sarnia, Ont., manufacturers of building products and highway materials.

Brig.-Gen. C. H. Mitchell and Prof. J. C. McLennan received the honorary degree, Doctor of Laws, last week at the University of Toronto, in recognition of their distinguished services during the war.

J. L. Thomas, formerly sales manager of the building supply department of the N. J. Dinnen Co., Winnipeg, is president and general manager of the recently organized Manitoba Clay & Building Supplies Co., Winnipeg.

Col. Alex. P. Deroche, of Napanee, Ont., has resigned his commission in the Canadian Engineers to accept appointment as general manager of Bate, McMahon & Co., contractors, Ottawa, succeeding the late Col. R. S. Low. Col. Deroche is a civil engineer and a graduate of the Royal Military College, Kingston.

William Worth Pearse, city architect of Toronto, has resigned in order to accept appointment as business administrator of the Toronto Board of Education at a salary of $8,000 per annum. Mr. Pearse was born December 4th, 1872, in Toronto and was educated at the Toronto public schools and Jarvis St. Collegiate. He studied architecture for 3 years under Kennedy & Holland, and for about 2½ years under Wm. G. Storm, who was architect for University of Toronto and other large buildings. Mr. Pearse passed the final examinations of the Ontario Association of Architects and then went to New York to study civil engineering, taking the degree of B. Sc., and later a 3-year post-graduate course in structural engineering. While in New York he was connected with a number of engineering companies and architects of more or less prominence, among whom were the American Bridge Co.; Levering & Garrigues, construction engineers; and the Radley Steel Construction Co., of which Mr. Pearse became chief engineer and vice-president, in which position he was connected with the construction of a number of important buildings in New York. In May, 1914, Mr. Pearse returned to Toronto to accept the position of city architect at a salary of $5,000 per annum. During his 5½-years' stay in the city hall, he revised the building by-law, the printing of which has just been completed. Particular attention was given in its preparation to flat-slab concrete construction and to brick work, and much research work was done and many tests were made before writing some portions of the new by-law. Mr. Pearse is an associate member of the American Society of Civil Engineers and a member of the Ontario Association of Architects.

M. B. Weeks, formerly Director of Surveys of Saskatchewan, has been appointed Director of Town Planning, and W. A. Begg, formerly townsite engineer for the Department of Highways of that province, has been appointed Town Planning Engineer by the Dominion government.

D. H. McDougall and Thomas Cantley, who are respectively president and chairman of the board of directors of the Nova Scotia Steel & Coal Co., Ltd., are on a tour of the coal mines and steel plants in England, France and Italy, and of the iron mines in Spain, Norway and Sweden.

George B. Mitchell, who is well known in Montreal, where he resided a number of years, and who for the past eighteen months has been construction engineer with the Foundation Company at Port Huron, expects to sail this month for Peru in the interests of the Foundation Company.

Col. H. R. Lordly, consulting engineer, Montreal, has been awarded the McGraw Fellowship in civil engineering by Cornell University. Col. Lordly is a Cornell graduate and a Fuertes gold medal winner. He is now at Ithaca doing research work. He expects to receive the degree of Master of Civil Engineering next June.

Lt.-Col. W. G. MacKendrick, president of the Warren Bituminous Paving Co. of Ontario, was one of a number of veterans who were decorated at the Parliament Buildings, Toronto, last week by the Prince of Wales. Col. MacKendrick received the Legion d'Honneur. During the war he was Director of Roads for the Fifth British Army.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand or proposed, contracts awarded, changes in staffs, etc.

ADDITIONAL TENDERS PENDING

Not Including Those Reported in This Issue

Further information may be had from the issues of *The Canadian Engineer*, to which reference is made.

PLACE OF WORK	TENDERS CLOSE	ISSUE OF	PAGE
Baintree, Alta., erection of frame school building	Nov. 18.	Nov. 6.	48
Montreal, Que., briquetting machinery	Dec. 14.	Nov. 6.	54
St. Clements, B.C., bridge	Nov. 19.	Oct. 16.	48
Toronto, Ont., water meters	Nov. 18.	Oct. 30.	45

BRIDGES, ROADS AND STREETS

Dundas, Ont.—The ratepayers passed a by-law to provide $3,500 for the construction of a new bridge over the creek at Head St. Engineer, J. W. Tyrrell, Hamilton.

Enderby, Alta.—Tenders will be received by the Honorable the Minister of Public Works up to noon of Wednesday, November 19th, 1919, for the erection and completion of a highway bridge over the Shuswap River at Enderby, B.C. Plans and specifications may be seen or obtained at the Department of Public Works, Parliament Buildings, Victoria, B.C.; at the offices of the district engineer, Court House, Vancouver, B.C., and at the offices of the assistant district engineer, Vernon, B.C.

Erickson, B.C.—Tenders will be received by the Hon. the Minister of Public Works, Parliament Buildings, Victoria, B.C., up to noon of Tuesday, November 25th, 1919, for the erection of a highway bridge over the Goat River, near Erickson. Plans and specifications may be seen at the Department of Public Works, Parliament Buildings, Victoria, B.C.; at the office of the District Engineer, Court House, Vancouver, B.C., and the office of the District Engineer, Nelson,, B.C.

Fredericton, N.B.—Tenders are being called by the Provincial Department of Public Works for flooring for the highway bridge at Andover, Victoria County, and rebuilding the Lucas bridge, parish of Chipman, Queens County.

Fredericton, N.B.—The Canadian National Railway authorities have had plans and specifications prepared for the erection next spring of a new bridge near here. Tenders will be called.

Galt, Ont.—Ald. S. J. McLane, chairman of the Board of Works, introduced by-laws at a recent meeting of the city council, providing for the construction of cement sidewalk on the south side of Oxford St., from Bond St. to Dundas St., and a sidewalk on the west side of Forest Rd., from Cedar St. to Waterloo Ave. Ald. McLane will also introduce a by-law to construct a sidewalk on Hobson St.

Kitchener, Ont.—At a special meeting of the Waterloo county council held recently, by-laws were passed establishing the township road between Elmira and Floradale as a county road. This road will be a continuation of the provincial county road from Elmira to Hamilton.

Niagara Falls, Ont.—City Engineer D. T. Black's estimates for pavement on Palmer and Kitchener Streets were passed by the city council. St. Clair Ave. may also be paved as far as Queen St.

Oakville, Ont.—Town council will obtain an estimate on a Tarvia pavement for Park Ave. Clerk, W. E. M. Crawley.

Pembroke, Ont.—Town council is considering the construction of a concrete walk on the south side of Elizabeth St., from Moffat St. to Indian River. Town engineer, W. J. Moore.

St. Barnabe de Gatineau, Que.—Tenders will shortly be called for by A. A. Gelinas, St. Barnabe, Nord, Que., for gravelling the municipal road at a cost of $16,000. Engineer, M. Henry, Roads Department, Parliament Buildings, Que.

Stanbridge East, Que.—Municipal council decided to send delegates to meet the Provincial Minister of Roads, to urge immediate action by the government for the construction of the proposed highway between Lacolle and Knowlton. Mayor, H. Beatty.

Toronto, Ont.—Tenders, addressed to the Chairman, Board of Control, City Hall, Toronto, will be received up to noon, Tuesday, November 25th, 1919, for the construction of asphalt pavements, concrete curbings and concrete sidewalks on several streets. Specifications may be obtained at the Department of Works, City Hall.

Toronto, Ont.—The board of control decided to hold over the construction of the St. Clair pavement to Keele St. until the spring.

Toronto, Ont.—The Civic Works Committee decided to revive the Teraulay St. extension scheme, which was abandoned during the war period. It is suggested that the street be opened to a width of 86 ft., from College St. to Davenport Rd. Works Commissioner Harris will make a further report on the matter.

Victoria, B.C.—A petition has been presented to the provincial government by J. E. Armishaw, of Sayward, Salmon River, Vancouver Island, for an appropriation for the building of a main highway, from Campbell River, 38 miles north to Salmon River, and the erection of a bridge across the Campbell River,

Victoria, B.C.—The streets committee of the city council, on recommendation of City Engineer F. M. Preston, ordered that the matter of improvements for Lang St. be referred to next year's council.

Welland, Ont.—City council passed a by-law authorizing the opening of Pine St. through to Aqueduct.

WATER, SEWAGE AND REFUSE

Assiniboia, Man.—The rural municipality of Assiniboia intends to undertake the following improvements: The laying of water mains along Emo St. and Oakdean Rd., and the erection of a pumping station, the sinking of a well and supplying same with all necessary machinery, on Woodhaven Boulevard. Secretary-treasurer, Frank Ness, Kirkfield Park P.O., Man.

Brandon, Man.—City council decided to have several water mains laid in the east end of the city. City clerk, H. Brown.

Bridgeburg, Ont.—Tenders addressed to R. A. Land, clerk, Bridgeburg, Ont., will be received up to 6 p.m., November 17th, for the supply and installation of a 24-in. Bell and Spick cast-iron intake pipe 200 ft. long. Also the supply and installation of an intake crib. Plans and specifications may be seen at the clerk's office.

Galt, Ont.—Ald. S. J. McLane, chairman of the Board of Works, introduced by-laws at a recent meeting of the city council, providing for the construction of a sewer through Dickson Park and on James St., Myrtle Ave. and Huron St., and on Portland St., from Cambridge to Oxford St., and on Oxford St., from Portland St. to Dundas St.

Hamilton, Ont.—Works Committee recommended the extension of the Burlington St. sewer to serve the plant which the Firestone Tire and Rubber Co. will erect in Barton Tp. Estimated cost, $34,000. A water service is also being arranged.

Hamilton, Ont.—City Engineer E. R. Gray is completing plans for an overflow sewer system, and a by-law will be submitted to the ratepayers in January, provided the plans receive the sanction of the board of control. Approximate cost, $300,000.

Hamilton, Ont.—The recommendation of City Engineer E. R. Gray that two sewers be laid on Barton St., between East and Victoria Avenues, was endorsed by the Works Committee.

Lindsay, Ont.—At the last meeting of the town council, Engineer F. A. Dallyn, of the Provincial Board of Health, submitted a report on relief for the town's south ward system of sewerage, in which he recommended the construction of three disposal plants.

Moose Jaw, Sask.—City council awarded a contract for 20 man-hole frames to the Standard Foundry Co., Longueuil, Que., at $18 each, f.o.b., Longueuil.

Niagara Falls, Ont.—Tenders will be received by W. J. Seymour, city clerk, City Hall, until 4 p.m., on Monday, November 17th, for the construction of sewers on Elm and Morrison Streets, Homewood, Fifth and Sixth Avenues. Plans and specifications may be seen at the city engineer's office, Bamfield Block.

Niagara Falls, Ont.—City Engineer D. T. Black will call for tenders for the construction of several sewers.

Pembroke, Ont.—Town council is considering the extension of water main on Fischer St.

Pembroke, Ont.—The Provincial Board of Health has approved the following works to be constructed by the town council: Waterworks mains in McAllister St., from McKay to Commercial St., and in Isabella St., from Maiden Lane to Doran St. Sewer extensions in Bell, Fraser, Pembroke and Cecilia Sts, in the East Ward, and in Christie and Somerset Sts., Government and Forced Roads in the West Ward. Town engineer, W. J. Moore.

Port Arthur, Ont.—The Utilities Committee authorized the laying of a temporary water main on Montreal St.

Sandwich and Ojibway, Ont.—Proposals will be received by the Essex Border Utilities Commission until November 27th, for completing the South Sewage Interceptor in Sandwich and Ojibway, Ont. Plans and specifications may be obtained at the office of Morris Knowles, Ltd., 66 Ouellette Ave., Windsor, Ont.

Scarboro Tp., Ont.—The township council decided to submit to a vote of the ratepayers on January 1st the proposition to lay out a water system for the southwest corner of the township. The section to be served is bounded by Danforth Ave., the waterfront, the city limits and Kennedy Road.

Stratford, Ont.—The by-law providing for repairs to the Abraham Archer drain was given the necessary three readings and passed by the city council. City engineer, A. B. Manson.

LIGHT, HEAT AND POWER

Minnedosa, Man.—J. M. Leamy, Provincial Power Commissioner, Winnipeg, will direct operations for the erection of a power plant for the supply of electrical power to Minnedosa. The plant will be of a temporary nature, pending investigation as to whether or not the town could be supplied with power economically from Winnipeg.

Port Elgin, Ont.—Ratepayers passed the by-law to secure Hydro power.

Regina, Sask.—Ratepayers passed a by-law granting a franchise to the McLaws Syndicate for natural gas.

Saskatoon, Sask.—Tenders will be called shortly by the High School Board for necessary alterations in the hydraulic pumps in the steam heating plant of the Saskatoon Collegiate building.

Winnipeg, Man.—Tenders addressed to the chairman, Committee on Fire, Water, Light and Power, will be received at the office of C. J. Brown, city clerk, up to 3 o'clock p.m., on Monday, December 1st, 1919, for the supply and installation of six 1,000 k.v.a. step-down, single-phase transformers for the city light and power department. Specification may be obtained at the office of the city light and power department, 54 King St.

Winnipeg, Man.—Tenders, addressed to the Chairman, Committee on Fire, Water, Light and Power, will be received at the office of C. J. Brown, city clerk, up to 3 o'clock p.m. on Monday, November 17th, 1919, for the manufacture, delivery and erection in the power house of the city of Winnipeg at Point du Bois of two units of horizontal shaft turbines for direct connection to alternating current generators and governors for controlling same. Specifications may be obtained at the office of the City Light and Power Department, 54 King Street.

RAILWAYS

Guelph, Ont.—The operation of the Guelph Radial Railway, in conjunction with the proposed system from Hamilton to Galt and Kitchener was urged on the city council on November 3rd, by Sir Adam Beck, who submitted the report of the Hydro-Electric Power Commission on the condition of the railway. He also forecast the construction of a line from Galt, past Puslinch Lake to Guelph, which would be a feeder for the Guelph radial. Sir Adam estimates that an expenditure of $150,000 would be necessary to put the Guelph road in good running order.

Manitoulin Island, Ont.—A party of C.P.R. officials, including Vice-President Grant Hall, recently visited Manitoulin Island to investigate the needs and possibilities of a railway on the island.

North Bay, Ont.—A survey party, which set out last spring to find a route for the contemplated extension of the

ESSEX BORDER UTILITIES COMMISSION

Proposals will be received by the Essex Border Utilities Commission until November 27th for completing the South Sewage Interceptor in Sandwich and Ojibway, Ont.

The work consists of laying approximately the following lengths of reinforced concrete lock-joint pipe in four-foot lengths, which is now on the work.

42" diameter—16'
39" " —4360'
27" " —4320'

Building fifteen (15) concrete and brick manholes and setting cast-iron frames and covers; pumping and clearing out four thousand (4,000)feet of existing sewer 42" and 27" in diameter, and shaping up ditches; replacing 80 sq. yds. of concrete street pavement.

The depth of the excavation is approximately 13—15 feet consisting of sand and clay.

The work lies along a concrete-paved roadway, and is readily accessible. The contractor will be required to furnish suitable pumping equipment.

Plans and specifications may be obtained at the office of Morris Knowles, Ltd., 66 Ouellette Ave.

Essex Border Utilities Commission.

GORDON McGREGOR, Chairman. W. J. BAXTER, Secretary. 374

WANTED.—Tarpaulins wanted, state size, condition and price. Box 27, *The Canadian Engineer*, Toronto.

WANTED.—Salamanders wanted, state condition and price. Box 29, *The Canadian Engineer*, Toronto.

T. & N.O. Railway, from Cochrane to James Bay, has been compelled to abandon the work and return to North Bay in consequence of inability to secure proper help for packing supplies. The party, it is reported, had covered about 100 miles, which is half the distance to James Bay. J. Maher, the engineer in charge of the work, has hopes of completing the work next year, and, in the meantime, he will prepare and submit a report on what has been accomplished this season. The survey party, Mr. Maher states, found a fairly good route over the first 75 miles, but beyond that the country was very largely muskeg and swamp. Railway building through that district will be possible, but very difficult.

Ottawa, Ont.—Hon. C. J. Doherty stated in the House of Commons on November 10th that it would cost approximately $1,750,000 for laying steel on the Hudson Bay Railway from Kettle Rapids to Port Nelson. He also said that the government does not propose to purchase the Edmonton, Dunvegan and British Columbia Railway at the present time.

Quebec, Que.—It is rumored here that the Delaware & Hudson Railway proposes to purchase a chain of small railroads in Quebec district. The company may also build new lines and extensions, including one to the Quebec bridge.

Quebec Province.—An unofficial report states that the Canadian Pacific Railway is considering the advisability of extending its Kipawa branch to the northward, for the time being to terminate near the north end of Lake Timiskaming which would necessitate the construction of about 65 miles of line.

Windsor, Ont.—Representatives of nine border municipalities, Windsor, Walkerville, Ford City, Sandwich, Ojibway, Sandwich East township, Sandwich West township, Anderdon township, Tecumseh and Amherstburg, decided to have the ratepayers vote December 6th on the question of authorizing the Hydro-Electric Power Commission of Ontario to purchase the Sandwich, Windsor and Amherstburg Railway for $2,039,000.

FACTORIES AND LARGE BUILDINGS

Alcomdale, Alta.—A new townsite, on the line of the E., D. & B.C. Railway, to be known as "Alcomdale," has been incorporated. Several companies will erect buildings, including the E., D. & B.C. Railway, and the Gillespie Elevator Co.

Biggar, Sask.—Tenders will be received up to November 28th, 1919, for the erection of a Union Hospital Nurses' Home and Isolation Hospital. Plans and specifications may be obtained at the office of J. Melrose Morrison, architect, Saskatoon, Sask.

Brantford, Ont.—A by-law may be submitted to the ratepayers to authorize the erection of a new grand stand at Agricultural Park at a probable cost of $50,000. City clerk, H. F. Leonard.

Benton, N.B.—Robert Hay, of Woodstock, N.B., is making arrangements to build a mill here.

Calgary, Alta.—The Alberta Stock Yards Co. contemplates improvements to their stockyards, including new buildings.

Calgary, Alta.—The Universal Motor Cars, Ltd., will erect a garage.

Campbellton, N.B.—The Fraser Co., Ltd., will erect two new lumber mills here.

Cloverdale, B.C.—A new station is to be erected by the British Columbia Electric Railway on their Fraser Valley line at Hunt Rd.

Earl Grey, Sask.—A movement is on foot here for the erection of a memorial hospital.

Drummondville, Que.—The H. W. Gossard Co., Inc., Chicago, have decided to erect a plant here. Estimated cost, $75,000.

Fort William, Ont.—The Sugar Products Co., of New York, has secured a site in this city and will build a large storage warehouse.

Fort William, Ont.—The Fort William Arena Co., Ltd., has been incorporated for the purpose of erecting a rink. C. H. Jackson is one of the provisional directors.

Fredericton, N.B.—Improvements are to be made to the Y.M.C.A. building.

Galt, Ont.—The city council gave the first and second readings to a by-law to loan $20,000 to the Perfect Machine Co. for the purpose of extensions. It is expected it will go to the electors in about six weeks' time.

Galt, Ont.—Galt may have a municipal aerodrome, since this city has been chosen as a location on one of the aerial routes mapped by the Aero Club of Canada. Lt.-Col. W. G. Barker, president of the club, will take the matter up with the civic authorities.

Glace Bay, N.S.—The erection of a new central school will likely start in several weeks' time. The building is to be a wooden structure, 36 by 70. Plans and specifications have been prepared by J. H. Morley. Estimated cost, $35,000.

Halifax, N.S.—Contract let to M. E. Kiefe for building a new wing to the Holy Heart Seminary, according to plans prepared by A. E. Priest. Tender price, $80,000.

Halifax, N.S.—School Board proposes to erect a new school in the west end of the city.

Hamilton, Ont.—Construction of another unit of the technical school, which is being urged by Principal G. L. Sprague, will likely be started next year.

Hamilton, Ont.—In a report on the city's proposed athletic field, Engineer E. R. Gray estimates the cost of construction to be $106,000, this figure to include two grandstands with a seating capacity of 2,000 each. A by-law will likely be submitted to the ratepayers in January.

Hamilton, Ont.—The ratepayers of Barton township ratified both by-laws providing for a fixed assessment for the Firestone Tire and Rubber Co., which proposes to erect an immense plant in the township. Plans of the buildings have been completed and contracts will be let within a few weeks.

Hamilton, Ont.—A permit has been issued to the Duncan Lithographic Co., for an addition to their plant on Bay St. N., at a cost of $10,000.

Kingston, Ont.—Plans are under way for the erection of a new school building in Seeley's Bay district.

Kingston, Ont.—A movement is on foot by the civic hotel committee for the erection of a new hotel next year.

Kitchener, Ont.—The Kitchener Housing Commission has closed a contract with W. N. McEachren Sons, Ltd., for the erection of houses to relieve the shortage here. It is expected that before spring over a hundred houses will be available.

London, Ont.—The I.O.D.E. will erect a war memorial Children's Hospital, which will likely be located on the grounds of Victoria Hospital.

London, Ont.—The London Life Insurance Co., has announced that it will begin the erection of a new office building next year at a cost of more than half a million dollars.

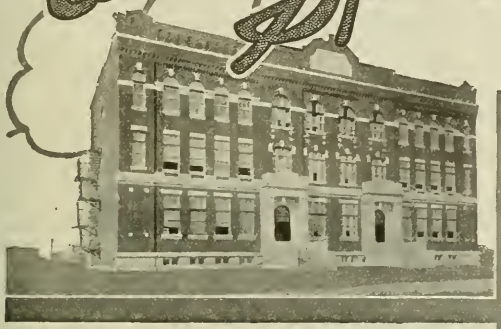
London, Ont.—Contract let to Hyatt Bros. for the erection of a $200,000 addition to the plant of the McClary Manufacturing Co.

London, Ont.—The London Chamber of Commerce has announced that a large factory, requiring several acres of land, has been secured for this city, and that it has already bonded a valuable site. The name of the industry will not be given out until the officers of the concern reach this city, which will be in a few days.

London, Ont.—The Western Fair Board has requested the city council to submit a by-law to the ratepayers on January 1st, authorizing the purchase of additional land and erection of new buildings at the Western Fair Grounds. Approximate cost of buildings, $1,025,000.

Manitoba Province.—Applications for the creation of hospital districts under the Municipal Hospital Act from Birtle, Deloraine, Melita, Pipestone, Souris, Eriksdale and

Barrett Specification Roofs



20-Year Barrett Specification Roof on St. Marc's School, Montreal. Owners: Catholic School Board, Montreal. Architects: Vautrin & Bernier, Montreal. Gen. Cont.: Ulric Boileau, Limited, Montreal. Roofers: Canada Roofing & Paving Company, Montreal.

20-Year Barrett Specification Roof on Old Orchard Avenue School, at Notre Dame de Grace. Owners: School Commissioners of Notre Dame de Grace, Montreal. Architects: Audet & Charbonneau, Montreal. Roofers: Tremblay & Francoeur, Montreal.

The *modern* way to buy a roof—

When the two school buildings shown above were completed, we handed their owners, the Catholic School Board of Montreal, Surety Bonds which *guarantee* the roofs against trouble or maintenance expense for a period of *20 years*.

The probabilities are that these roofs will last for nearer *30 years* without attention.

This is the *modern* way of buying a roof, not merely purchasing so many square feet of roof at so much per square foot, but investing in a long and definite period of *guaranteed service*.

The Barrett Specification first made it possible for building owners everywhere to obtain, through their local contractors, *a standardized roof* built according to the most scientific principles of roof construction.

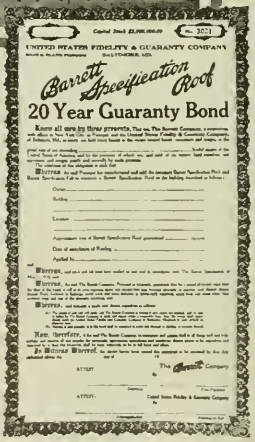
Guarantee 20 Years of Service

Now we offer to go a step further and actually *guarantee* a Barrett Specification Roof *for a period of at least 20 years!*

This guarantee, obtainable on any roof of 50 squares or more, in any town of 25,000 or over, and in smaller places where our Inspection Service is available, is in the form of a Surety Bond, issued by a well-known fidelity company.

To obtain the Bond you have only to insert in your building specifications the following:

"The roof shall be laid according to The Barrett Specification dated May 1, 1916, and the roofing contractor shall secure for me (or us) the 20-Year Guaranty Bond therein mentioned."



UNITED STATES FIDELITY & GUARANTY COMPANY
BALTIMORE, MD.

Barrett Specification Roof
20 Year Guaranty Bond

This is the bond that guarantees your roof for twenty years.

The guarantee costs you nothing. We merely require an opportunity to send our Inspectors to watch the job during construction.

You get a roof that will cost less per year of service than any other type of permanent roof, and that takes the base rate of insurance. We get the satisfaction of knowing that our materials are creditably used.

We should be very glad to send you further details and copy of the Barrett 20-Year Specification, with diagrams, ready for insertion in your building plans.

The Barrett Company
LIMITED

MONTREAL TORONTO WINNIPEG VANCOUVER
ST. JOHN, N.B. HALIFAX, N.S. SYDNEY, N.S.

Russell have been approved by Hon. J. W. Armstrong, provincial secretary. The aggregate cost will be approximately $200,000.

Mimico, Ont.—Ford and Clark, local real estate agents, will erect an apartment, store and office building.

Moncton, N.B.—A movement is on foot for the erection of a rink. B. E. Reardon is interested.

Moncton, N.B.—Tenders will be received up to noon, November 17th, 1919, for the erection of new offices, etc., for the Atlantic Underwear Co., Ltd. Plans and specifications may be obtained from J. W. Fraser, architect, 132 Steadman St., Moncton, N.B.

Nanoose, B.C.—The Nanoose Lumber Co., Ltd., will erect a mill near here. Manager, Chas. R. Hardy.

New Westminster, B.C.—Contract for the erection of the Canada Western Cordage Company's plant at Sapperton has been let to the E. J. Ryan Contracting Co., Ltd., of Vancouver, at $76,000. The contract calls for the erection of administration buildings, warehouse and factory building 150 by 200 ft., to be constructed of interlocking tile and reinforced concrete.

New Westminster, B.C.—A proposal to utilize the old jail for the purpose of a technical school, making structural alterations to the building, has been placed before Hon. J. D. MacLean, Minister of Education and Provincial Secretary, Victoria, B.C., by the school trustees of this city. Estimated cost of alterations about $12,000.

Niagara Falls, Ont.—The by-law to raise $50,000 for additions to the hospital will be resubmitted to the ratepayers at the January elections.

Oakville, Ont.—Tenders addressed to Molesworth, West & Secord, architects, 808 Royal Bank Building, Toronto, will be received till 12 noon, on November 15th, for the erection of a public school at Oakville. Plans and specifications may be seen at the office of the architects, or of the secretary of the Board of Education, Oakville.

Oakville, Man.—A movement is on foot for the erection of a rink here.

Ottawa, Ont.—It is expected that the work of reconstructing the Parliament buildings will be completed in time for use at the next session of Parliament, according to a statement made by Hon. A. L. Sifton, Minister of Public Works. To date reconstruction has cost in the neighborhood of six million dollars and about two million dollars more will have to be expended.

Ottawa, Ont.—The government have decided to go ahead with the reorganization of the printing bureau and have tabled an estimate in the House for $275,000, part of which is to cover the cost of structural alterations and the purchasing of new machinery.

Ottawa, Ont.—The city council has decided that the Reid Farm property, Parkdale and Carling Avenues, is the best location for the new civic hospital. Twenty-six acres of land is being acquired at a cost of $77,850 and plans will now be prepared.

Ottawa, Ont.—The possibility of Queen's University establishing one of the best medical colleges in Canada, in Ottawa, on a site adjacent to that for the new civic hospital, has almost become a surety. Last Monday a committee from the college faculty conferred with the Board of Control and members of the Civic Hospital Committee.

Penetanguishene, Ont.—The McGibbon Lumber Co. may rebuild their mill which was recently destroyed by fire.

Peterboro, Ont.—The city commissioners have accepted the tender of the Dominion Bridge Co. for the supply of steel for the new telephone building. The amount involved is $18,290, being 148 tons of steel at $123.58 per ton. It is expected that the contract for the construction of the building will be awarded to J. Dunlop at $80,468.

Port Arthur, Ont.—The Great Lakes Paper Co., Ltd., will commence immediately the erection of a huge plant costing between $5,000,000 and $6,000,000, just east of Port Arthur city limits. The plant is to consist of a groundwood mill with an annual output of 30,000 tons, a sulphite mill, annual capacity 7,500 tons and a newsprint paper mill of 3,330 to 3,500 tons annual output. Power from the Hydro-electric plant at Nipigon will be used, from 12,000 to 16,000 h.p. being contracted for delivery at the plant, at a cost of $17.50 per h.p., by December 31, 1920. Engineers headed by Hardy Ferguson, of New York, are to be on the ground within a few days. Foundations will be commenced at once, if weather permits. The plant is to be in full operation by June, 1921. The personnel of the company is: Lewis L. Alsted, president, Combined Locks Paper Co., Wis.; George Seaman, president, Seaman Paper Co., Chicago; and James Whalen, president, Port Arthur Shipbuilding Co. The firm is to employ thousands of men in construction and operation. A site of 100 acres has been given free by J. J. Carrick out of his 600-acre holdings immediately east of Port Arthur. Port Arthur will extend its street railway to the site.

Port Coquitlam, B.C.—The Great War Veterans of this district propose to erect a memorial hall and club headquarters. Committee in charge, Messrs. Kidd and Irvine.

Port Coquitlam, B.C.—The Gregory Tire and Rubber Co. will erect a plant here at a cost of $175,000, providing the provincial government approves of a by-law to grant the company a bonus of $40,000. The managing director of the company is J. A. Cunningham, president of the B.C. Manufacturers' Association.

Port Haney, B.C.—School board is considering the erection of school buildings.

Quebec, Que.—Negotiations are pending which involve the transfer of the Montcalm Hotel property into the hands of an hotel syndicate, of which Frank A. Dudley, of Niagara Falls, N.Y., is president. The erection of a large new hotel on the site is planned.

Quebec, Que.—The Catholic School Commission is considering the erection of new schools in the Sacred Heart parish. Chairman, J. B. Morissette.

Raleigh Tp., Ont.—A new school will be erected in School Section No. 16. Building Committee: Charles Obrey and Fred. Holland.

Redcliff, Alta.—An enlargement is to be made to the plant of the Dominion Glass Co., at a cost of $100,000, the chief expense being the installation of a new furnace.

Regina, Sask.—Contract let to J. G. Traub for the erection of a showroom and service station for the Willams Motor Co., on Cornwall St. Work has started. Estimated cost, $30,000. Architects, Storey & Van Egmond.

Regina, Sask.—Plans are under way for the erection of a community hall in connection with the Imperial Oil Company's works. Estimated cost, $20,000.

Saskatoon, Sask.—At a recent mass meeting held here it was unanimously decided to build a $30,000 hockey rink.

Saskatoon, Sask.—The High School Board decided to urge upon the city council the preparation of a by-law for submission to the ratepayers in December, authorizing the construction of extensions to the present building amounting to $300,000. Chairman, A. M. McIntyre.

Saskatoon, Sask.—Among the buildings to be erected in this city next year are the following: Addition to the Collegiate Institute, $300,000; Normal School, public school, King George Hotel and City Hospital.

Sherbrooke, Que.—A movement is on foot by the I.O.D.E., for the erection of a tubercular sanatorium.

Ste. Agathe, Que.—The Provincial government will shortly grant a large sum of money for the enlargement of the tubercular hospital here, according to a statement made by Hon. Walter G. Mitchell, provincial treasurer.

St. Catharines, Ont.—St. Catharines will be one of the stopping places on the aerial route which is being planned, and the city council has been asked to give its views with reference to the building of an aerodrome here. A committee will make a report on the subject.

St. John, N.B.—After discussing the need for a new municipal building, costing $1,000,000 to $2,000,000, the local board of trade decided to urge the city council instead to restore the municipal court house, which was gutted by fire last winter.

Burlington Steel Co., Ltd.
Hamilton, Canada

STEEL BARS
For
Concrete Reinforcing

THE MOST IMPORTANT FACTOR IN CONCRETE REINFORCEMENT IS THE TENSILE STRENGTH AND ELASTIC LIMIT OF THE REINFORCING BAR.

OTHER THINGS BEING EQUAL, STEEL HAVING THE HIGHEST ELASTIC LIMIT, OR YIELD POINT, WILL BE THE MOST SATISFACTORY FOR REINFORCEMENT. WHEN UNDER STRAIN, AS SOON AS THE ELASTIC LIMIT OF ANY REINFORCING BAR IS REACHED, THE METAL STRETCHES RAPIDLY DECREASING IN SECTION, DRAWING LOOSE FROM THE CONCRETE AND DESTROYING THE MONOLITHIC BOND EXISTING BEFORE THIS POINT IS REACHED THEREFORE, THE SAFETY OF THE ENTIRE CONSTRUCTION IS IN DIRECT PROPORTION TO THE ELASTIC LIMIT OF THE STEEL USED.

THE ELASTIC LIMIT OF RAIL CARBON STEEL IS 50,000 TO 60,000 POUNDS PER SQUARE INCH, EITHER TWISTED OR PLAIN, AS COMPARED WITH AN ELASTIC LIMIT OF 25,000 TO 30,000 POUNDS IN SOFT STEEL.

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PROMPT SHIPMENT

Stratford, Ont.—The Canadian General Electric Co. has purchased the Mooney buildings in this city, and will remodel same and install new machinery for the manufacture of electrical appliances.

Toronto, Ont.—A site has been purchased for the erection of a library building in Earlscourt district and work will likely start next spring. Estimated cost, $50,000.

Toronto, Ont.—The following building permits have been issued by the city architect: H. Grieman, six-story brick warehouse, 129-139 Spadina Ave., near Richmond St., $100,000. Anthracite Briquette Co., two-story warehouse, north side Commissioner St., near Ashbridge's Bay, $9,600. Prince's, Ltd., alter building formerly occupied by Fairweather, 84-88 Yonge St., $30,000.

Toronto, Ont.—M. Mitchell has taken out a permit to erect a five-story solid brick warehouse at the north-east corner of King and Simcoe Streets, at a cost of $681,000.

Toronto, Ont.—The plans for the new sub-post office, corner of Carlaw and Danforth Avenues, have been completed and forwarded to the postmaster-general's department at Ottawa for approval.

Toronto, Ont.—Mayor Church is taking up with the C.P.R. the question of erecting a new station in Riverdale, and with the G.T.R. the erection of a new station north of St. Clair to replace the present Davenport station.

Trenton, Ont.—A new rink will be erected on Quinte St. Clerk, J. W. Delaney.

Unionville, Ont.—The municipal council have instructed the E. A. James Co., Ltd., 36 Toronto St., Toronto, to prepare plans for a township memorial hall. The building will cost approximately $20,000. A by-law will be submitted to the people on January 1st.

Vancouver, B.C.—George Taylor, of the firm of Leitch and Taylor, 413 Granville St., is the man behind the scheme for the erection of a $600,000 apartment house at the corner of Bute and Barclay Streets.

Vancouver, B.C.—The Merchants Bank has purchased a site on the west side of Granville St., and will erect a new bank building early next year. Superintendent, A. C. Fraser.

Victoria, B.C.—Contract let to J. Halkett and E. J. Hunter, at $10,375, for erection of annex to Oakland School.

Walkerville, Ont.—The school board decided to establish a continuation school here.

Waterloo, Ont.—The Waterloo Curling Club has purchased a building for use as a rink, and will erect an addition to same. President, J. J. Weir.

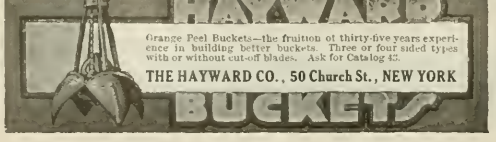
Welland, Ont.—City council received a letter from Lieut.-Col. W. G. Barker, president of the Canadian Aero Club, stating that as Welland is on one of the important aeroplane routes it is desirable that an aerodrome should be erected here.

West Toronto, Ont.—W. Speers will erect a three-story building on Dundas St., opposite Medland St.

White Rock, B.C.—At a recent meeting of the G.W.V.A., local taxpayers and the White Rock A. and H. D. Association, it was decided that the White Rock War Memorial should take the form of a combined club-house for veterans and a public library, the building to be erected at an estimated cost of $10,000.

Windsor, N.S.—The Alumni Association of King's College decided to raise funds to the amount of $50,000 for the erection of a memorial hall.

Windsor, Ont.—The Burroughs Adding Machine Co., Detroit, has purchased a site and will erect a plant here.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BUCKETS

Windsor, Ont.—Application for a charter is being made by the Border Cities Hotel Co., which is to erect a million-dollar nine-story hotel here. Among the provisional directors are Hiram H. Walker and Gordon McGregor.

Windsor, Ont.—The St. Clair Country Club, Ltd., plans erection of a new clubhouse next season. President, Col. E. S. Wigle.

Windsor, Ont.—The Auto Specialties Co. have commenced building operations on their 10½-acre site in this city. Their first unit will involve one large and three small buildings, having a total floor space of about 50,000 square ft. When completed and equipped, this unit will represent an investment of fully $200,000. The plant will eventually cover the entire site. Work on the second unit will commence next summer. The construction contract is in the hands of S. E. Dinsmore & Co. The Canadian Bridge Co. are erecting the steel, and J. C. Pennington is associate architect with Davidson & Weiss, of Chicago.

Windsor, Ont.—Tenders will be received up to November 29th for the erection of the new $400,000 public school. Architect, A. H. McPhail.

Windsor, Ont.—Paul Gilbert has purchased a site on Wyandotte St., and will construct a large store and apartment block next summer. Estimated cost, between $20,000 and $25,000.

Winnipeg, Man.—City council is considering the erection of a new market building. City clerk, C. J. Brown.

Winnipeg, Man.—A permit for a $6,000 addition to the Canadian Malting Company's factory has been granted by the building inspector.

Winnipeg, Man.—A permit has been issued for the erection of an $85,000 emergency building to relieve the congestion in the present quarters of the University of Manitoba. Deputy Minister of Public Works, S. C. Oxton.

Woodstock, Ont.—On December 1st an industrial by-law will be submitted to the ratepayers authorizing a loan of $20,000 to the Warren Pipe Organ Co., Ltd., to enlarge their plant.

York Township, Ont.—Township council decided to proceed at once with work on the eight-roomed addition to Secord school. Township clerk, W. A. Clarke, 40 Jarvis St., Toronto.

MISCELLANEOUS

Calgary, Alta.—The following by-laws will be voted on by the electors at the coming municipal elections: Sewage disposal, $350,000; waterworks, $372,316; hospital, $135,000; Louise bridge, $155,978; total, $933,294.

Chilliwack, B.C.—Tenders for the work in connection with the Sumas reclamation scheme will shortly be called for by the provincial government. It is expected that the scheme will involve the expenditure of well over a million dollars, and the reclamation of some 32,000 acres of land in the now low-lying section in the vicinity of Chilliwack.

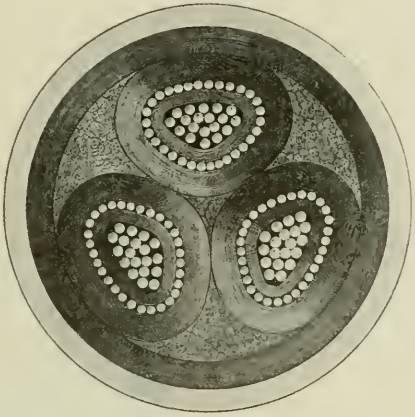
Fort William, Ont.—A large ore dock, capable of handling over 2,000 tons an hour, will be constructed here, according to information received by Mayor Murphy. Estimated cost, $100,000.

Hamilton, Ont.—New plans for the extension of the harbor improvements provide for a wall on the west side of Wellington St., and a slip 600 ft. wide, which will cost in the neighborhood of $160,000. It is proposed to extend the wall across to Wentworth St., filling in all the space behind it.

Hamilton, Ont.—The board of control voted down the recommendation of the Works Committee that a by-law be submitted to the ratepayers in January authorizing the expenditure of $25,000 on civic wading pools and $75,000 for the development of the mountain brow, as suggested in the report of Noulan Cauchon, town-planning expert.

Ladner, B.C.—In order to provide for necessary repair work to the diked area of Delta, the municipal council recently passed a by-law empowering the borrowing of $12,000.

SPLIT-CONDUCTOR CABLES



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London, Ont.—By-laws aggregating more than $1,500,000 will go before the people in January next. They include $300,000 for extensions to the Western fair grounds; $200,000 for the London and Port Stanley Railway; $250,000 for the Board of Education for new schools, etc., $200,000 for the commencement of a new city hall; $100,000 for a new reservoir; $100,000 for new bridges; $85,000 for a new stable and shelter for vehicles for the city; $20,000 for additional playgrounds; and many other smaller items. In addition it appears likely that the citizens will be called upon to vote on the question of the purchase of the London Street Railway, which would mean at least another million and a half dollars.

Moose Jaw, Sask.—At the recent meeting held in this city in connection with the Moose Jaw water proposition, delegates from Riverhurst, Sask., raised the question of a much needed bridge across the Saskatchewan River, the extension of the Grand Trunk Pacific west to meet the C.N R. Eston-Dunblane line and the construction of a power dam to supply the country for a radius of 200 miles with power. The matter was introduced by Mr. McDonald, of Riverhurst. While it was considered that it was not a matter that could be taken up with the provincial government at the same time as the water proposal, it was felt that the traffic bridge at least should be pushed at Regina, and that the Dominion government should be communicated with as to the rest of the proposal. No definite action was taken on the matter by the meeting, but the Riverhurst delegates were assured of the heartiest co-operation of Moose Jaw.

Ottawa, Ont.—The time for receiving tenders for kitchen equipment for the Parliament Buildings, has been extended to noon, November 15th, 1919, and the date for the completion of this work has also been extended to February 7th, 1920. John A. Pearson, architect, Centre Block, Parliament Buildings, Ottawa.

Ottawa, Ont.—Tenders addressed to R. C. Desrochers, secretary, Department of Public Works, Ottawa, will be received until 12 o'clock noon, Wednesday, November 26, 1919, for the supply of eleven pontoon discharge pipes for dredge "P.W.D. No. 5." Plans and specification may be obtained at the offices of the mechanical superintendent of dredges, Birks Building, Ottawa and the superintendent of dredges, St. John, N.B.

Powell River, B.C.—Tenders addressed to R. C. Desrochers, secretary, Department of Public Works, Ottawa, will be received until 12 o'clock noon, Tuesday, November 25th, 1919, for dredging in front of wharf at Powell River, district of Comox-Atlin, B.C. Combined specification and form of tender may be obtained on application to the secretary, Department of Public Works, Ottawa, at the offices of the district engineers, Victoria, B.C., New Westminster, B.C., and at the post office, Powell River, B.C.

St. John, N.B.—The contract for dredging here has been awarded by the Dominion government to J. A. Gregory, of West St. John, the amount of the contract being twenty thousand yards at 33c. a yard.

Sydney Mines, N.S.—The Dominion Coal Co. will open a colliery in the vicinity, according to a statement made by Mark Workman, president of the company. Mr. Workman said that the new mine would be sunk at Bonner Point, in the Florence district, and intimated further that operations in that locality would be carried out on a large scale. Some two million dollars will be spent in developing these areas, installing the most modern equipment available and building miners' houses, which will be provided with a waterworks system. The president foreshadowed the establishment of steel shipbuilding on a large scale.

Toronto, Ont.—At a private conference with the Board of Control on November 10th, the Harbor Board secured consent to the issue of $4,000,000 of debentures for Toronto harbor development, $2,500,000 will be spent upon the inner harbor between Bathurst and Yonge Streets, and the bulkhead wall will be continued from Yonge St. eastward, with the marginal way and Fleet St. to the north of it, these two great highways, 84 and 86 ft. wide being designed as the great warehouse and loft-building thoroughfares of the Greater City.

Vancouver, B.C.—Aldermen Kirk, Shelly and Owen have been appointed a committee to represent the city council in co-operating with a committee of the Vancouver Real Estate Association to place before the harbor commissioners a definite plan for port improvement.

Vancouver, B.C.—Arrangements are being completed by Percy H. Fraser, of the Vancouver Magnetite Iron and Steel Smelting Co. for the installation of an electric smelter near this city, whereby the ores of this province will be broken and reduced to first-class pig iron. The company is capitalized at $1,000,000, and the plant is expected to cost $35,000.

Vancouver, B.C.—The deep sea shipping interests of Vancouver decided to petition the Dominion government to construct a floating drydock here.

Victoria, B.C.—It is reported here that the Dominion government plans to place contracts for fifty wooden schooners with British Columbia shipyards. According to the report, twenty-five of the ships will be constructed at this port, and the other half will be turned out by yards on the mainland.

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The Canadian Engineer

A Weekly Paper for Civil Engineers and Contractors

Earth Slides in Winnipeg Aqueduct Construction

Description of the Principal Methods Used by the Contractors in Dealing with the Sloughs and Slides—Bearing Tests Demonstrated Instability of the Soft Dark Clay, Analysis of Which Showed 15% of Moisture and Water of Combination

By DOUGLAS L. McLEAN

Formerly Division Engineer, Greater Winnipeg Water District

EARTH slides in the open trench used for the construction of Winnipeg's 100-mile aqueduct were of such magnitude as to impede seriously the progress of the work. Considered by themselves, they afford an interesting study in the flow of clay under pressure and in the effect of water on the movement of large masses of earth; but viewed together with the other phases of the work, they appear as an index of the difficulties that had to be overcome in order to construct safely the aqueduct through the 10 miles of summit cut where peat bogs, 6 to 14 ft. deep, covered fine

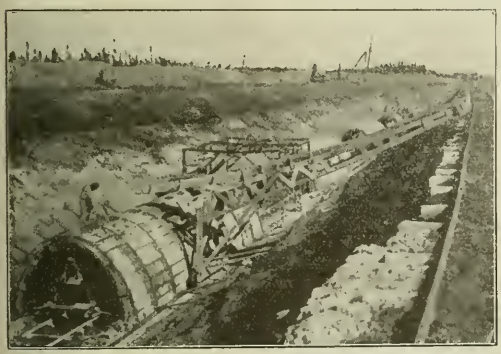


FIG. 1—INDICATING OPERATIONS IN BUILDING AQUEDUCT UNDER NORMAL CONDITIONS

sand, sandy clay and blue clay, which moved readily under comparatively light pressures.

Under normal working conditions, the water of the peat bogs was drained away along the centre line by means of a pilot ditch constructed by the contractor during the first years of his work. The Water District Railway's side-ditches to the south, and protective drainage ditches to the north, of the aqueduct line, also aided in the disposal of surplus surface waters. With the main volume of the water removed by these drains, the contractor's regular program of work was as indicated in Fig. 1.

First, the main trench, about 20 ft. deep, with 16 to 20-ft. base, was excavated with side slopes of 1: 1, by means

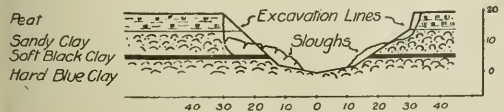


FIG. 2—DIAGRAM SHOWING SMALL SLOUGHS

of a Class No. 24 Bucyrus drag-line excavator, which placed the material removed into spoil banks 75 to 100 ft. on each side of the trench centre line.

With the spoil at such distances, there was ample room on the north for the travelling derrick, which was used to remove the final trimming taken out by hand labor just before the fresh invert concrete was placed; and room

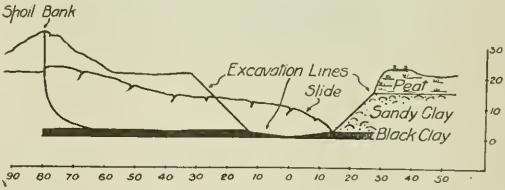


FIG. 3—DIAGRAM SHOWING SLIDE

was also left for the narrow-gauge railway which was used to transport the concrete from a central mixing plant to the forms used for moulding the aqueduct.

Pumps were spaced at intervals, depending upon the quantities of ground water that escaped into the trench, and, by aid of box-drains, kept the foundation in shape for final trimming and permitted the invert concrete to be placed in the dry. The concrete invert, or floor of the structure, was poured in 15-ft. sections, while the arch, or horse-shoe-shaped portion of the concrete pipe, was moulded in

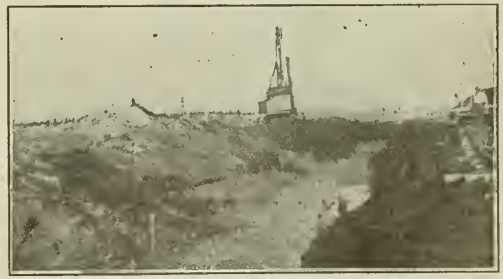


FIG. 4—SLIDE—NOTE SETTLEMENT OF SPOIL BANK

45-ft. lengths by use of steel forms. Reinforcement was placed in the invert where soft foundation was encountered. As soon as the concrete had been properly cured, the pipe was backfilled by the same drag-line that was used for the excavation.

With the spoil divided and placed well back from the trench, with excavation slopes of 1:1, and with drainage, there would appear to have been small possibility of slides; but even these precautions were not sufficient when the soft dark, waxy clay was encountered. This clay varied from a dark black to a pale gray color, depending upon the amount of drying it had received. When in its natural state it was very plastic and soft, but when air-dried it became extremely hard and showed great shrinkage. This stratum of soft clay occurred throughout long stretches of the trench and varied in thickness from 1 ft. to over 50 ft. In some places it occurred 5 or 6 ft. above invert grade, and in other places it occurred at the bottom of the excavation. In such places

FIG. 5—TRAVELLING DERRICK REMOVING PORTION OF SLIDE ALONG CENTRE LINE

as the latter, heavy inverts and piling were used to carry the structure. The chemical analysis of this clay was as follows:—

Moisture and water of combination ..	15.10%	Chromic oxide	1.40%
Silica	34.75%	Calcium	5.30%
Iron oxide	15.20%	Magnesium	3.25%
Alumina	24.10%	Sulphates	2.90%

The accompanying table gives some bearing tests to show the difference between this soft clay and other materials encountered on the work.

Whenever this clay was encountered, movement of the trench walls took place. These movements varied from local sloughing, as shown by typical example in Fig. 2, to large slides, as shown by typical examples in Figs. 3 and 4. In the latter cases, the spoil bank appeared to settle vertically and to squeeze the material into the open trench. This had the effect of cracking the earth and allowing water to get into the mass. This water lubricated the earth and soon accumulated a head which tended to produce further motion. In addition, the water under a head forced its way into otherwise impermeable material and extended its lubrication. This combination of water pressure and lubrication kept the materials moving from time to time at various rates of speed, depending on the local conditions. As an example of the manner in which this clay transmitted vibration: The drag-line runner dropped a cubic yard of solid clay from a height of 10 ft. above the bottom of the trench, to the north of the structure, which was carried on piles (see Fig. 7). Standing on the opposite bank, 60 ft. away and 18 ft. above, one could feel the jar from the impact of the earth on the trench bottom.

The principal methods employed by the contractor to overcome these slides were:—

1. On the section of trench where the soft clay occurred near the bottom of the trench, and where the structure was carried on piles by use of special inverts, the sliding material was moved far back, an extra width of trench bottom was excavated (see Fig. 7) and the bank was sloped at a flat angle. This removal of the slide, as it were, meant the handling of large quantities of excavation, and later, of backfill.

2. Where firm material lay under the sliding materials, the method adopted was to flatten one slope and remove by the Class No. 24 drag-line such material as it could reach from the opposite side of the slide. This flat slope was allowed to drain and harden by air-drying. Then the final excavation along the centre line was made (as shown by Fig. 5) by means of a travelling derrick and hand labor. This method did not involve the handling of as much earth

TABLE 1—BEARING TESTS ON VARIOUS MATERIALS, WINNIPEG AQUEDUCT

Area of pedestal, 36 sq. ins. Weight of pedestal, 121 lbs.

Under "Duration," read 17:16, "seventeen hours and sixteen minutes"; read 0:32, "thirty-two minutes"; etc.

Station	Foundation	Immediate (in feet) Under 3 Bags of Gravel	Immediate (in feet) Under 12 Bags of Gravel	Duration in hrs. and minutes Under 12 Bags of Gravel	Penetration in feet Under 12 Bags of Gravel
4623+25	Dark gray clay* ...	.022	.082	17:16	.232
4637+80	Dark gray clay	.000	.013	1:18	.015
4677+50	*Soft dark clay	*.006*	*.997*	*0:32*	*1.057†*
4679+80	*Soft dark clay	*.234*	*.434*	*1:12*	*.966*
4769+25	Sandy clay	.031	.289	17:40	.457
4772+05	*Soft dark clay	*.023*	*1.120‡*	.....	....
4800+00	Sandy clay	.015	.196‖	1:23	.324
4818+00	Bluish clay	.007	.059¶	1:48	.188
4831+50	*Soft dark clay	*.022*	*.902*	*26:47*	*1.074*
4840+90	Blue clay with pebbles	.004	.382	18:32	0.459
4854+00	Blue clay with pebbles	.017	.077	28:35	0.100
4845+40	Blue clay with pebbles	.004	.116	4:40	0.181
5093+00	Yellow clay	.002	.011	17:35	0.036
5087+25	Heavy blue clay	.002	.009**	1:45	0.019
5078+00	Yellow and blue clay	.001	.028	8:32	0.050
5028+30	Grayish blue clay ...	.004	.032	19:53	0.052
5005+18	Blue clay with sand.	.003	.029	16:39	0.033

*Dark gray clay just under the muskeg; had a water-bearing sand stratum below the bottom of the invert.
‖Resting on braces.
‡Platform and posts went down to braces before all bags were put on.
¶Water around base of post.
†Trace of water around the post.
**Under 11 bags of gravel.

as did the first method, but it was only successful where the excavation was far ahead of the concrete work.

3. Pole-sheeting of the trench was used through a section of slide when the drag-lines were busy on other slides.

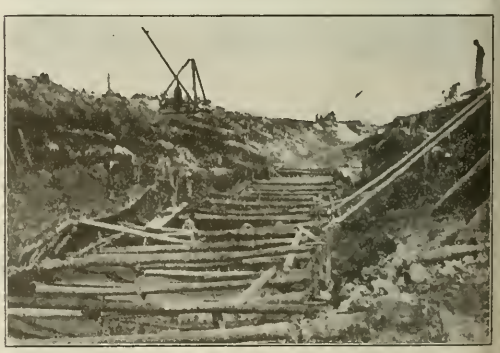


FIG. 6—SHEETING THROUGH SLIDE

This pole-sheeting and bracing is shown in Fig. 6. This was a slow method of work, as special overhead bracing was required to allow the steel forms to be moved along the trench. The overhead bracing used to hold the slides while the arch concrete was being poured, was not as heavy as the first bracing placed, as by drying out the material near the pole sheeting the pressures were reduced. This

method required the moving of the smallest quantities of earth, but used the maximum amount of common labor.

While these were the three principal methods used by the contractor, various other methods of depositing spoil, draining the trench sides and sloping the side of the trench were tried. Each section of slide had peculiarities of its own and had to be dealt with as sound judgment and experience directed. In some places special heavy inverts were all that was required to hold the earth in check, while nearby the side pressure was sufficient to move piling spaced

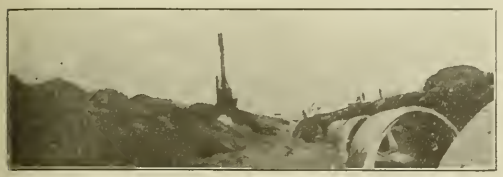


FIG. 7—SLIDE SHOWN IN FIG. 4 REMOVED AND AQUEDUCT CONSTRUCTED

at 3-ft. intervals and cross-braced with 12-in. round timbers. Theoretically, water could be held to be the cause of all these slides, as it destroyed the cohesive qualities of the soft clay; its pressure acted as equivalent of millions of jack-screws and it further helped movement by lubrication; but in such cases as these slides, theory was of little use and reliance had to be placed on experience and sound judgment. In the employment of such, the Winnipeg Aqueduct Construction Co. were fortunate in having Wm. Smaill as field superintendent and manager, while the Greater Winnipeg Water District were equally fortunate in having W. G. Chace as chief engineer.

RECENT PUBLICATIONS

MUELLER BRASS GOODS.—Cloth-bound catalogue, 8¼ by 11 ins., 276 pages and cover, printed on coated paper, profusely illustrated; issued by the H. Mueller Manufacturing Co., Ltd., Sarnia, Ont., describing their water, plumbing and gas brass goods.

CONCRETE TANKS FOR INDUSTRIAL PURPOSES.—A 36-page illustrated pamphlet, 6 by 9 ins., published by the Portland Cement Association, illustrating and describing concrete tanks for water, mineral oils, brine, molasses, vegetable and animal oils, tanning liquids, dairy products, chemical solutions, etc.

QUEBEC STREAMS COMMISSION.—Seventh report, covering year 1918; 120 pages and paper cover; 6¾ by 9¾ ins.; illustrated; accompanied by several folded maps anl diagrams. O. Lefebvre, of Montreal, is chief engineer and secretary of the commission. Two of the three commissioners are civil engineers, namely, W. I. Bishop and Arthur Amos. The chairman of the commission, S. N. Parent, is a lawyer.

WROUGHT TUBULAR PRODUCTS.—Catalogue issued by the Page-Hersey Iron, Tube & Lead Co., Ltd., 100 Church St., Toronto; printed in two colors on coated paper; well illustrated; 76 pages and cover, 4½ by 7½ ins. It includes illustrations, weights, dimensions, diagrams and specifications for lap-welded and butt-welded pipe; pipe with flanged joints and bell and spigot; electric line tubular poles, service clamps, well tubing, etc.

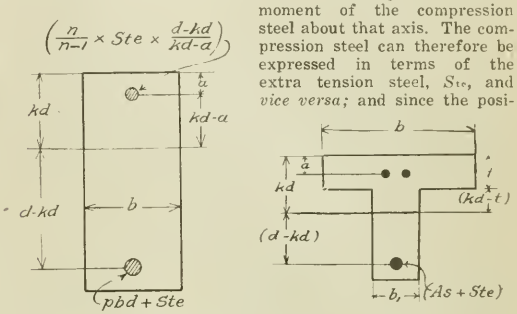
PROVINCE OF SASKATCHEWAN.—Booklet prepared by F. H. Kitto, under the direction of the Superintendent of the Natural Resources and Intelligence Branch, Ottawa; 154 pages and paper cover, 6½ by 9¾ ins. The contents include chapters on historial description, government, transportation, communication, education and religion, climate, soil, agriculture, cities and towns, forests and water powers, minerals, fish and game; illustrated by maps, charts and half-tones.

DOUBLY REINFORCED CONCRETE BEAMS

BY E. MONTGOMERY
Regina, Sask.

AT times structural requirements limit the concrete section of a beam and it becomes necessary to add compression steel to enable it to sustain a given bending moment. In such cases the amount of tensile and compressive reinforcement required can be found by the following method.

When compression steel is used, the amount of ordinary tension steel, pbd, is increased by an amount, S_{te}, the first moment of which about the neutral axis is equal to the first moment of the compression steel about that axis. The compression steel can therefore be expressed in terms of the extra tension steel, S_{te}, and *vice versa;* and since the position of the neutral axis in a reinforced concrete section depends only upon the modular ratio and unit working stresses in concrete and steel, when these and the concrete section are given, the position of the neutral axis is fully known.



With the preceding remarks in mind, the theory applied to the solution of the following problem will be clear.

Example.—It is required to reinforce a concrete section 14 by 27 ins. to sustain a bending moment of 1,081,920 inch-lbs. The depth of embedment of both tensile and compressive reinforcement is to be 3 ins.; working stresses in concrete and steel to be 640 lbs. per sq. in., and 16,000 lbs. per sq. in. respectively, and the modular ratio to be 15.

$$I = Mkd/f_c, \text{ or } nM(d-kd)/f_s.$$

Also, $I = b(kd)^3/3 + npbd(d-kd)^2 + nS_{te}(d-kd)(d-a)$.

For the given stresses and modular ratio, $k = 0.375$ and $p = 0.0075$. Since the effective depth of section is 24 ins., $kd = 9$ ins.; $(d-kd) = 15$ ins.; $(d-a) = 21$ ins.; $pbd = 2.52$ sq. ins.

Substituting and equating:—

$14\times 9^3/3 + 15\times 2.52\times 15^2 + 15S_{te}\times 15\times 21 = 1{,}081{,}920\times 9/640.$

$\therefore$ 4,725 S_{te} = 3,307.5.

$\therefore$ S_{te} = 0.7 sq. in.

pbd = 2.52 sq. ins.

$\therefore$ Total tension steel = 3.22 sq. ins. and compression steel $= 15/14\times 0.7\times 15/6 = 1.875$ sq. ins.

In solving for T-beams of given concrete section, the only variation is in the method of computing the amount of ordinary tensile reinforcement. This is done as follows:—

Sum of compressive stresses $= A_c f_c/2 = b_1 kdf_c/2 + t(b-b_1)[f_c + f_c(kd-t)/kd]\times \frac{1}{2} =$

$$(f_c/2)[b_1 kd + t(b-b_1)(2-t/kd)].$$

Casting out $f_c/2$, concrete compression area $= A_c = b_1 kd + [t(b-b_1)(2-t/kd)]$. This equation appeared in an article by the writer on page 458 of *The Canadian Engineer* for April 15th, 1915.

Ordinary tension steel $= A_s = A_c f_c/2f_s$.

As before, $I = Mkd/f_c$, or $nM(d-kd)/f_c$.

Also, $I = b(kd)^3/3 - (b-b_1)(kd-t)^3/3 + nA_s(d-kd)^2 + nS_{te}(d-kd)(d-a)$.

The Union of Alberta Municipalities has asked the provincial government to make an investigation of the hydro-electric possibilities of Alberta, with a view to formulating a policy for publicly owned power plants. A resolution to this effect was adopted at the Union's recent convention.

THE PLANNING OF LAND IN RELATION TO MUNICIPAL AND SOCIAL PROBLEMS*

By Thos. Adams
Town Planning Adviser to the Dominion Cabinet

IN Canada and the United States the land has been planned, but not scientifically. As a rule, land has been planned on the lines that are easiest, and with little regard to economic use and natural conditions, or on the lines that suit the narrow point of view of the private speculator. We have witnessed the folly of that haphazard and wasteful method; nearly every municipality on this continent is paying the cost of bad planning.

All municipal government centres in the various phases of land development, both in town and country. Every public utility has to obtain its justification from the service it renders to land and improvements erected upon it; and the cost of government is high or low in proportion as the land is wisely or unwisely developed. We need scientific planning in both our rural and our urban districts, and it must have for its primary object the development of our resources (including human life) and the increase of production.

Must Apply Scientific Principles

We need only fear increase of population and over-production if we do not raise the standard of life, of comfort and of efficiency of our population, and to accomplish these things we must lay out and develop the land with these as the main purposes in view.

If we desire to increase wealth, we must apply scientific principles to the planning of the future growth of our cities, towns, villages, rural townships and metropolitan regions comprising portions of each,—so as to increase the productive use of land, lessen the burden of taxation caused by unproductive utilities, create better facilities for carrying on industries (including improved methods of transportation) and promote public health and more agreeable conditions of life for the citizens.

The art of city, town and rural planning is in its infancy, and the scientific data required to afford guidance to the planner is very inadequate. Whatever need there may be for planning, the greater need at the moment is the determination of the right principles on which planning should be carried out and the discovery of the rational order of things to be dealt with in the plan. In other words, city and town planning has to follow the true logical order, and be developed to a greater extent as a science before it can take its rightful place as an art. Investigation, by means of observation and experiment, to discover facts and their mutual relations, must precede all creative work in connection with any reform of our social conditions.

Character of Suitable Areas

We must have a constructive social outlook to which to work, and acquire adequate knowledge of the underlying conditions on which to build up our plans before we start to prepare them. The objective we should aim to reach is the development of a healthy and efficient social and industrial organization which will give us the maximum of production coupled with the highest degree of equality of opportunity. With regard to the methods of acquiring knowledge, we must recognize that we have to deal with a combination of physical and social conditions that overlap at every point. We have to make a survey of both these sets of conditions, and before we do so we must determine the character of the areas that are best adapted both for the preliminary study and for subsequent plans.

Our political units are divided into three main groups, —national, provincial or state, and local. These divisions are arbitrary and are not always best adapted for planning. For instance, in the Niagara region, the planning of future industrial growth is international, in Kansas it is inter-state, and in nearly every city it is inter-municipal or metropolitan.

Manufacturing industry is ceasing less and less to be influenced by city boundaries, and on the other hand the necessary relationship between manufacture and agriculture compels attention to the overlapping problems on both sides of the boundaries of every city and town and creates regional problems. Perhaps the worst housing problem in America is to be found in the "buffer" area, or "no man's land," that lies just over the boundaries of the cities. Something must be done to bring about the co-operative action of adjacent local authorities to deal with this problem.

To plan properly and control industrial and residential areas we have, therefore, to introduce a new geographical unit, namely, the regional area. The Niagara district is such an area, so also are the metropolitan areas of Greater London, Greater New York, Greater Montreal and Greater Boston. The study and comprehensive planning of these regional areas is one of the most pressing of our social needs, and should precede the planning of the local incorporated areas within them.

The division of areas might be given as: (1) National or federal; (2) provincial or state; (3) regional, i.e. any combination of incorporated local areas, or parts of such areas, forming an industrial region; (4) incorporated local (urban or rural), e.g. city, town, village or county area.

National and Provincial Plans

What has been called "nation planning" is incomprehensible in the sense in which we use the term "city planning." You cannot plan a nation, nor yet a state or province in any detail. But there are certain things both in the nation and state or province that should be dealt with from the comprehensive point of view of a central authority.

It should be a rule never to do anything by a centralized form of government that can be efficiently dealt with by a local form of government. The local government authority in a free commonwealth should have the maximum of power and responsibility consistent with efficiency. Granted that this is true, we recognize that the sphere for national or state planning must be very limited. The character and scope of the national operations will depend on the character and scope of the national jurisdiction.

In Canada the federal government has different powers and duties from those of the federal government of the United States, and what I have to say in respect of the former will not apply in detail to the latter,—although the general principles will be applicable to both.

The question may be asked whether the limited scope of planning available to our federal and state or provincial governments is not amply provided for in our political organization. The answer is in the affirmative, so far as power to deal with the matter is concerned. In the exercise of that power, however, the political measures of our central governments in relation to the development of land are not directed with proper care towards the object of the public welfare and are not preceded to a sufficient extent by scientific investigation.

Limits of Governmental Knowledge

This does not question the intentions of governments, but indicates their self-imposed limits of knowledge of the problem as a comprehensive whole.

We have good departmental heads, and experts are employed under them to investigate social problems in compartments within the powers granted by political parties. But too frequently we introduce political measures, and set up administrative machinery to deal with social problems on the basis of isolated examples instead of on the basis of scientific investigation of facts and conditions.

The function of the federal government should be to investigate the broad national aspects of the problems of land development, industrial location, health and transportation. We have our departments available to deal with these prob-

*Excerpts from paper read November 14th, 1919, before the American Society for Municipal Improvements, at New Orleans, La.

lems but more co-ordination and constructive planning is needed. The four things that come directly within the purview of the federal government are:—

(1) Preparation of topographical maps; (2) waterways, railways and main highways; (3) subdivision of areas in undeveloped territory, and land settlement in connection with such areas; (4) co-ordination of provincial schemes of land settlement, railway extension and highway improvement.

Need for Topographical Maps

We greatly need accurate topographical maps in Canada. The gain to local authorities by having such maps would be enormous. Every structure, field and fence and the physical conditions and levels of the land have been accurately mapped in Britain. The result is that local authorities are saved the expense of local surveys to ascertain existing conditions, and to enable them to carry out local improvements economically. Only national governments can adequately undertake that work. Canada and the United States are so large and scattered that the preparation of complete topographical maps could only be undertaken gradually, but it should be undertaken in respect of large extents of area—especially those that are well populated—without delay.

We have effective means of controlling the working of our waterways and railways, but no constructive policy of directing new extensions as a part of a national scheme of development. The interest of the community needs to be safeguarded to a greater extent in connection with the planning of railway enterprises.

We are giving large sums from our federal government for highway construction, but need to keep in mind that the chief interest of the federal government in good roads is in co-ordinating and assisting the provincial schemes of main highways so as to form the skeleton of a national scheme.

The federal government has a direct interest in controlling water powers and directing commerce, and, therefore, in the establishment of new centres of industry. In Canada it owns large sections of unorganized territory and is responsible for the planning of that territory for settlement. In its control of immigration it should have regard to future development according to plans as well as to existing needs.

Scope of Federal Planning

In federal planning we should deal only with the applications of definite principles to matters affecting the country as a whole, such as those I have mentioned. In state or provincial matters the federal authorities should, by consent, help to co-ordinate state functions and schemes, and always be available as a fountain-head of expert advice. To enable it to discharge that duty we need national surveys of existing conditions, such as were advocated in the United States by the Country Life Commission of the late President Roosevelt, and these surveys should include accurate topographical maps on a workable scale.

There should be set up a federal bureau of planning and development to carry out investigations and provide co-ordinating and advisory services. Only such a body could afford to subsidize investigations that go beyond what is of immediate practical utility, and only a government that will go beyond that stage will accomplish greater progress than other governments. In the domain of physical science little progress would have been made if men like Newton had restricted their work to what was of immediate practical utility; but still the "practical" man fails to see that he is deriving his success from the scientific work of those former days and only in a lesser degree from his own organizing ability.

The planning of the state or province follows the general lines of the planning of the nation. It does not get down to details, and should not interfere with local discretion. In all matters already referred to, it can supplement the work of the nation. It should have its state or provincial bureau to act in concert with the federal bureau in preparing topographical maps and surveys; planning waterway, railway and highway extensions and deviations; and planning new territory for permanent settlement. It must, however, go further, without encroaching on the rights of incorporated local authorities.

The state or province is the legislative authority in connection with matters of dispute between municipalities. In Canada the province is the court of appeal in connection with extensions of municipal boundaries. Again, when the rights of owners of property come in conflict with public or local government rights, the power of settlement rests with the state. To develop a proper town-planning policy, you must have co-operation between adjacent local authorities; means of bringing together urban and rural authorities to control properly the "buffer" areas between them; and means of maintaining a balance, in the interests of public welfare and freedom of contracts, between public and private interests in property. Here the power and value of the state or province are supreme.

Moreover, the application of a uniform code of by-laws or ordinances in regard to city and country planning is essential and can only be achieved by state legislation. Subject to state or provincial planning laws that determine the procedure and general principles to be followed in local schemes, especially in regard to the matters of over-lapping jurisdiction and rights of eminent domain, the power of the municipality should be supreme.

Regional and Town Planning

The federal bureau, as an advisory body and the directing agency in regard to topographical maps and inter-state or interprovincial means of communication, and the state or provincial planning and development boards operating under state or provincial planning laws to co-ordinate local schemes and regulate legal procedure, give us the centralized machinery we need. To be effective, each such machine would have to include a skilled director of planning and development to give his whole time to administration, and especially to give aid to the councils of the smaller local authorities.

We now come to consider the local work and machinery, and this brings us in contact with the real work of planning, which must always be dealt with by the local unit of administration. The local units will be incorporated areas except where regional schemes are necessary, and the surveying and planning of areas must be dealt with by joint boards representative of adjacent incorporated areas, in co-operation with the several local councils within the region.

As an example I might cite the regional area comprising five cities and towns known as the Border Cities and a portion of a country area in southwestern Ontario. These cities and towns are growing up side by side, serving the same industrial needs; unable to deal effectively with their public utilities except by co-operation; having a system of transportation and natural conditions that disregard incorporated boundaries; and all lacking control over the sanitary and industrial conditions overflowing their boundaries.

Essex Border Utilities Commission

The best way to illustrate the respective character of regional and town planning schemes is to describe the kind of scheme suggested by the Federal Office of Town Planning for this area. These five authorities have a Border Cities Utilities Commission which exercises some control over their public services. It is proposed that this commission should prepare a regional survey and plan for an area comprising the whole areas of the five cities and towns, and such part of the rural area outside as may be affected by their future growth. This regional survey and map would provide an exhibit of all existing conditions—physical, industrial, means of communication, buildings, local improvements, land values, etc. We thus get the essential foundation on which to plan.

The commission, having secured the survey and map, goes further and suggests the skeleton plan for dealing with the future growth of industry, transportation, residences, park areas, etc. This is only a tentative and skeleton plan of the region and is confined to main features which are common to the six authorities. It binds no one authority and conforms to no definite legal requirement.

When the regional survey and plan is completed, the next step has to be taken by each of the local councils. These

will have before them the town-planning laws of the province, setting out the procedure and confirming the necessary powers to secure proper sanitary conditions, convenience in relation to streets, and air space around buildings; and laying down the legal procedure. They will also have the regional plan, giving accurate details of existing conditions and indicating the matters that affect the neighboring authorities. On this basis, and with this information, they can proceed to prepare a detailed plan for each of their several areas, covering all matters they regard as necessary and special to themselves.

That is one variety of regional planning. There are many other varieties. There are cases like Calgary, Alta., where the city has an area of 24,000 acres for a city of 60,000 people. Here the regional plan is restricted to the incorporated city area, and within it provision is made for industrial, residential and agricultural development. Assessment is graded to suit the different purposes for which land can be used, and public utilities are confined to the parts of the area to be built upon before other parts are permitted to be developed.

The Niagara region is much greater in size and covers all the area in both Canada and the United States affected by the industrial development contingent on the power facilities obtained from Niagara Falls.

Coal mining areas are suitable for regional planning.

We thus see that the regional survey and skeleton plan must precede the city or town plan to get satisfactory schemes carried out.

This paper is of necessity a brief and general introduction to a great subject. It deals with only the outline of the principles that need attention to get more desirable forms of administration and control of land development. One or two arguments in favor of the co-operative action of municipalities under central guidance may be given in conclusion.

We are face to face with the fact that established industries all over this continent are leaving the cities and migrating to semi-rural districts, and that new plants are being erected to a greater extent in the semi-rural areas than in the crowded centres of cities. This tendency suggests two things:—

Frst, that the cities which are losing their industries and revenues should consider how to prevent future disintegration; and second, how to plan the suburban development around cities so as to prevent the recurrence of evils that have caused the dispersal of industries from the existing centres.

Industrial Centres Becoming Congested

It is largely a matter of land development, as the causes of the dispersal are associated with the dearness of land, the opportunities for expansion at reasonable cost, the facilities for transportation over the land, and the planning of residential areas suitable for housing close to the plants.

The proper control of land development is needed to prevent undue density of building in parts of our cities and undue scattering of buildings in other parts. Congestion has reached a point in most large cities where it has become impossible to carry on business with dispatch and efficiency, and where public utilities are strained beyond their capacity and causing severe losses to local authorities.

The scattering of residences and factories over our suburban areas, with the greater intervening areas of vacant lots, served by unproductive public utilities, has the same effect from a different set of causes. As cities grow, the costs of administration increase instead of decrease; transportation, while becoming more centralized, instead of being more economical, becomes more costly; and all the advantages of better sanitary conditions are lost because of lack of air space around the buildings.

The growing cost of food is not entirely due to war conditions. It is partly caused by the growing tendency to divide the city from the country and to create a cleavage between them as if their interests were not dependent on co-operation between the two. One of the biggest blunders on the American continent has been the encouragement of a system of land speculation that has sterilized the use of land in the suburbs of our cities. Tens of thousands of acres are lying idle waiting for buildings that will not come for generations, and producing no food at the door of the consumers.

These conditions need urgent attention if for no other reason than that most of our cities and towns are facing financial problems that will tax the wit of man to solve in the near future. Altering of the system of taxation will have no permanent effect if we do not control the development of land and the social forces of industry by adequate and comprehensive schemes of planning.

Summary

1. All land should be planned with the definite object of securing health, convenience and amenity in connection with industry and residence, and not for any object of speculation.

2. Scientific investigation of regions and municipal areas should precede the preparation of city and country planning schemes. We need to know more of the facts and their mutual relations before we employ the art of the regional or city planner.

3. The division of areas requiring consideration are: (1) National or federal; (2) provincial or state; (3) regional; (4) incorporated local.

4. National surveys and plans should deal with broad national and state aspects of development, such as preparation of topographical maps; planning of waterways, railways and national and state highways; and co-ordination of provincial or state schemes. The national organization should be largely advisory. The state scheme should supplement the federal schemes, and state law should set forth the procedure to be followed in connection with schemes for regional areas and incorporated local areas, and make provision for co-operation of adjacent municipalities and for dealing with conflicting public and private interests in property. A state or provincial planning and development board should be formed in each state or province.

5. Many industrial, mining and other areas are growing up without regard to incorporated boundaries and need to be surveyed and planned in regional units by co-operative action of the several authorities within them. Surveys and skeleton plans of these regions should be prepared in advance of city or town-planning schemes. A joint board, representative of the local authorities, should prepare the regional survey and skeleton plan.

6. The definite detailed plan should be prepared only by the incorporated local authorities, subject to consideration of the broad national and state aspects of the problem and to the regional aspects and conditions as revealed by the regional survey and plan. This local plan should fix the industrial and residential zones; deal with sanitary provisions, air space, convenience, local problems of transportation and amenity; and anticipate future growth for forty or fifty years. A local board, or commission, should give constant study to the planning of the incorporated area and to the execution of the plan, subject to control of the expenditure by the elected council having jurisdiction over the area.

7. Finally, the solution of our social problems and the proper development of our municipal improvements cannot be obtained by the mere art of planning, but by scientific investigation followed by plans based on sound economic principles and prepared with due regard to the ideals that should inspire every community that seeks to follow the path of real progress.

According to a report made recently to the city council of Peterboro, Ont., $116,618 has been spent to date on the Hunter street bridge, which is now being constructed.

Toronto's citizens will vote January 1st on the by-law providing for the guarantee of $4,328,665, Toronto's share of the $8,360,794 which the "Hydro" radial from Toronto to Bowmanville will cost according to the estimates made by the Hydro-Electric Power Commission of Ontario.

SANITATION AND MUNICIPAL DEATH RATES*

By George A. Soper
Major, Sanitary Corps, United States Army

BY sanitation is meant that branch of systematic health work which requires plant and a force to maintain it. Examples are works for the procurement and distribution of wholesome drinking water; the collection and disposal of liquid sewage; and the gathering and final disposition of kitchen waste, ashes and other discarded material. These are obviously sanitary undertakings but the list of improvements which go to make a city sanitary does not end here. Broad, well-paved market places; suitable playgrounds; bright, well ventilated schoolhouses; in short, whatever the city has in the way of plant which goes to prevent the injuries to health which result from too densely segregated masses of people, might properly be comprised under the head of sanitation; but in everyday parlance they are not so included.

Sanitation and Disease

Yielding to works of sanitation are not only typhoid, dysentery and other diarrheal diseases, but many other forms of sickness. To introduce a public supply of pure water in place of a polluted one, or to build sewerage in a town which has had no good way of disposing of excrement, is to reduce the prevalence of nearly every disease from which men suffer and die. Nothing that can be done is so certain to lessen the death rate.

Sanitary works possess a number of advantages as compared with other measures for the prevention of disease. For one thing, they do not require as high a degree of skill in their administration as do boards of health. For another, they have an advantage over personal precautions in not being individual in application and unco-ordinated in action. Sanitary works have a wholesome application. A water supply which is pure is wholesome for every person who has occasion to use it. The street that is well paved and kept clean is of advantage to every one who travels over it by vehicle or foot. And sanitary works do not hide their merits under a bushel. Their good effects are in plain sight —a constant recommendation of the good sense of those who are responsible for the welfare of the community.

Beginning of Municipal Sanitation

From the first, sanitation has been a feature of many American cities. Sanitation, although long delayed, when it came, came like a revolution to the continental cities of Europe. The beginnings of municipal sanitation everywhere are due to European initiative. Public water supplies, as we know them to-day, and sewers to carry away the most offensive and dangerous part of a city's filth, are recent European contrivances. Street lighting, good pavements, adequate transportation, tenement house reforms, the construction of parks and playgrounds, the regulation of vehicular travel and street paving and cleaning have been developed more recently. The American city which ignores foreign practice in these directions fails to take account of experience which can save it a great deal of money.

The sanitary regeneration which European cities have experienced has had no counterpart in the United States. There has been no necessity for such revolutionary changes. American cities were small when the world began to learn that sanitation was an indispensable feature of every municipality. There was never such over-crowding, such slums to clean, such foci of filth to clear up and eliminate, as existed abroad half a century ago. In 1860 there were only 16 cities in the United States with a population of 50,000 or more, as against 148 in Europe.

Municipal Growth in America

The significant feature of municipal growth in America as compared with that in Europe has been less the reconstruction of cities already large than the construction of a great number of small cities. Hundreds of these have passed and are now passing through their periods of infancy, youth and adolescense toward a maturity which foreign cities attained long ago. Their sanitation takes place as they grow.

Water Supply Comes First

The first important sanitary improvement to be made in the growing village is the public water supply. This leads to the use of water closets and, to accommodate the drainage from these, cess-pools are built. The privies, the original provision for the disposal of excrement, are then eliminated. Street pavements are presently considered and the cleaning of the pavement and the collection of house refuse by municipal effort follow. At first garbage is collected by scavengers at the private expense of the householders; later it is done at public expense. The young city may now be said to have passed through its period of infancy and entered that of youth.

A sewerage system is built later in the city's growth. During this period the houses are gradually built closer to one another and in a more permanent form of construction until they stand in a compact mass. More attention is given now to pavements and to the cleaning of them. Parks are laid out, lighting is improved, ordinances are passed regulating many sanitary matters. The city has now reached its period of adolescence.

The period of maturity, that is, the period in which civic responsibility begins fully to express itself, comes last. The regulation of building construction, the control of traffic and the adoption of far-sighted plans to insure public health and safety are often taken up at this time. They should have been considered at a much earlier period.

Business Men the Leaders

It is instructive to observe how often it is that a community owes its sanitary improvements to its business men. It might be supposed that the principles of sanitation were more within the grasp of professional men than of those whose attention was chiefly occupied with manufacture and trade, and that doctors and lawyers and ministers would be foremost to see that the health and welfare of the public were properly looked after. This is not, however, always the fact. There is no disposition to belittle the help which professional men can give, but an experience in public work which covers many years and extends over many cities and states shows that when it comes to municipal improvements, it is the commercial element which usually exercises both the initiating and sustaining influence.

The explanation of this is simple enough. The general subject of sanitation is not so complicated as to be the exclusive province of any class or profession. Certainly the need of sanitation and the benefits of it can be understood by every intelligent person. Business men are accustomed to weigh returns against expenditures and readily appreciate that sanitation is a sound investment. Moreover, they are accustomed to action and when they get together to obtain action for the public welfare they are apt to get it.

Technical Advice is Essential

Often the important thing to know is what to do in order to improve the sanitation of a city. Why is the death rate high? What should be done to reduce it under the particular circumstances which exist? In answering these questions many technical and financial details may have to be considered. This is properly the work of experts. An unprejudiced expert should be called on to make a report based on a study of the local situation and on a knowledge of what other cities have done and are doing under similar circumstances. This report should serve as a program behind which the solid, common sense of the municipality can array itself.

When a city needs a health program, as every city does, the best way to get it is for the business men to demand it of the municipal administration through their commercial organizations. If the municipality does not possess the talent for the work, an expert should be called in from out-

*From a paper presented at the second Pan-American Commercial Conference.

side. In many cases commercial organizations have themselves employed experts to make investigations and reports to serve as a guide to the citizens in demanding what is proper.

Health Should Determine Appropriations

The question is often asked, what can a city afford to spend for sanitation? The answer is that it can afford to spend whatever is necessary in order to make it healthy. If it is already healthy, it need spend but little; if it is unhealthy, it must, of course, spend more. A city, like a man, must have health if it is fully to realize its possibilities. Epidemics paralyze business, and a high death rate is a reflection upon the good business sense of a community. In many cases, investments for sanitation should be looked upon as policies.

Every city and every village ought to have a program of development, a plan to which to build, a settled scheme of construction to which to refer details. This program should be prepared early in order to keep the growth properly proportioned and prevent the excessive development of some relatively unimportant features at the sacrifice of the essential. Paramount in such a scheme should be suitable provisions for health.

Maintenance Charges Not Excessive

Although a considerable investment of capital has to be put into sanitary works, the maintenance charges are not excessive as compared with the administrative costs of hand labor, which is often used as a substitute to accomplish the same result. It must not be expected, however, that good sanitary works can be built or that they can be effectively operated without care. Skill and attention in design and construction and operation are indispensable to the best results.

Among the 219 cities of 30,000 or more population in the United States, for every $10 put out each year for all purposes of administrative effort, $1.10 on the average is expended for health and sanitation. The amount varies among the different cities, according to the natural advantages of the site with reference to water supply, drainage, kind of population and commercial and industrial conditions, and according to th foresight and business ability with which the work is planned and carried out. The percentage of the total yearly expenditure which is devoted to health and sanitation sometimes runs as high as twice the figure stated, and occasionally falls to about one-half of it. The size of the city does not affect the percentage.

The Provincial Builders and Supply Association of Ontario will hold its next annual meeting during the first week of February. The president of the Association is Herbert Elgie, Toronto.

The 1919 membership drive, which will be held by the American Association of Engineers during the first two weeks in December, has as its slogan "10,000 members in 13 days." All of the 90 clubs and chapters of the association are making final arrangements for the drive. Never in the history of engineering organizations has anyone ever before proposed such a great increase in membership within such a brief period.

The Associated Manufacturers of Water Purifying Equipment has now become a permanent organization, and will hold a meeting this month in Omaha, Neb. Although the organization was primarily formed for the purpose of securing necessary priority orders during the war, it will now continue largely for the purpose of taking up work in standardization of equipment sizes, of guarantees to customers and of terms of sales. The officers of the association are: Chairman, F. B. Leopold, Pittsburgh Filter Mfg. Co.; vice-chairman, Arthur M. Crane, New York Continental Jewell Filtration Co.; secretary, H. G. Tate, Borromite Co. of America.

WIDENING RADIUS FOR ELECTRIC POWER*

Transmission Over Lines Exceeding Three Hundred Miles Is Now Commercially Feasible at 220,000 Volts, Making Distant Waterfalls More Valuable

RECENT achievements are increasing the distances of economical transmission of electric energy. In long-distance transmission of electricity high pressures or voltages are required—the higher the voltage, the lower the losses. For several years after long-distance transmission had been introduced, it was the practice to allow a pressure of approximately 1,000 volts per mile. It was found, however, particularly with distances of over 100 miles, that the distance allowed could be increased to as much as two miles per 1,000 volts. In other words, lines operating at about 100,000 volts pressure have been transmitting energy over distances exceeding 200 miles. More recently, lines operating at 150,000 volts have demonstrated their practicability; one of these has been in successful operation for over five years.

Now electrical engineers are of the opinion that pressures of 220,000 volts are quite feasible, and it is stated that "the handling of electrical potentials of 220,000 volts does not appear to involve any disturbing complications or uncertainties. In fact, the manufacturers do not recognize that any serious problem exists. Current design principles and materials now in ordinary use will be employed, the principal difference from present high voltage equipment being the greater amounts of insulation and the larger clearances required. The step to 220,000 volts is relatively no greater than that previously taken from 66,000 volts to 110,000 volts or from 110,000 volts to 150,000 volts. Certain of the manufacturers have already developed designs, and assert readiness to undertake the commercial production of 220,000-volt equipment on short notice."

The advantages of long-distance transmission are of particular interest to Canada, where much of our water-power is found in large units, and, to reach many consumers, it may be necessary to transmit the energy for a considerable distance. It is perhaps of greatest interest in connection with our abundant water-powers in the River St. Lawrence and in the area lying to the north of the settled regions of the prairie provinces. It brings us closer to the possibility of making these vast stores of energy available within the settled portions.

In Saskatchewan, for instance, the power sites of the Churchill river are only some 250 miles from Saskatoon and 350 miles from Regina. The transmission of energy over these distances would be quite feasible at 220,000 volts, and economically possible when the demand of the entire district reaches a high enough figure.

*From "Conservation."

Armstrong Bros. Tool Co., of Chicago, are making extensive additions to their plant, buildings and equipment. The new buildings include an addition to the drop forge department, a new building for the hardening and heat treating department, and a new reinforced concrete building for the general office, finished stock and shipping department.

Among the speakers on the program for the Great Waterways Conference, which was held last Tuesday and Wednesday, November 18th and 19th, at Windsor, Ont., were E. L. Cousins, chief engineer and general manager of the Toronto Harbor Commission; Sir Adam Beck; and W. M. German, of Welland. Mr. Cousins was scheduled to speak upon the canalization of the St. Lawrence River and what it means to Great Lakes points. The subject of Mr. German's address was "Enlargement of the Canal System Between Lake Ontario and Montreal." O. E. Fleming and Alex. Simmers were expected to lead a discussion upon the advisability of forming a Canadian Inland Waterways Association.

TOWN PLANNING, WITH SPECIAL REFERENCE TO OTTAWA

By Noulan Cauchon
Consulting Engineer and Town Planner, Ottawa

(Continued from last week's issue)

It is the intention that both sides of the Rideau river and the Rideau canal shall be a parkway extending out beyond the limits of the city. That is coming; it is simply a question of time. The Rideau canal property is government property; it has been handed over to the Ottawa Improvement Commission with a view to their improving it so far as their funds will allow. Unfortunately the funds are largely tied up in fixed charges, so we cannot expect very much new work until the government helps us. Of course, I am looking at this thing not so much from the local point of view; if this city is to be worthy of being the capital of Canada, any accomplishments in that direction should be the result of the effort of the whole country. As a matter of fact, the only thing here that is truly "capital" is the Parliament Buildings site; on those grounds you cannot run in and do anything without the Dominion police nabbing you. Theoretically, then, the capital is confined to the Parliament grounds and the federal property along the canal.

Dominion Park near Ottawa

There is a very fine mountain range north of the city and not far from it. It was suggested some years ago by Mr. Macoun that this be made a Dominion Park, and that is a splendid suggestion; it is incorporated in the "plan." If that was made a Dominion Park like Banff, people could live there, under proper restrictions, because it is brought right to the door of the city.

I have advocated that the railroads, after they pass through the tunnel, should take the river's edge and eliminate also the barrier which in time will grow up on the present Canadian Pacific Railway tracks. Because that may be ten, fifteen or twenty years off is no reason why this trackage sheuld be left there until it becomes just as objectionable as any other of its kind. The general principle is this: Whatever your barriers may be, you have to go across them or underneath them or over them; get as many of them together as you can, therefore, and thus simplify the problem of dealing with them.

I do not admit that a railway cannot be made a thing of beauty. A proper railway embankment, well planted and kept in good order, carrying the passengers along where they can see the scenery, is just as much a contribution to beautification as is a great boulevard. Why do we build paved roads all over the country? We have visitors who come here who are fortunate enough to be able to ride around in automobiles and see our beautiful parks. But why should we not enable the thousands who travel in trains to get the same impression of this country, of this city, or of any city in America? Why should the only impression we give the stranger who travels on trains be the one that he receives from looking at our back yards and clothes lines? I want the railway to be on a boulevard, so that the thousands of people who travel here on trains will get the same impression as the man who is fortunate enough to be able to go round and view the scenery in an automobile.

Scenery for Railway Passengers

I was in Niagara Falls, N.Y., the other day, at the invitation of the Chamber of Commerce, and I was talking with some of the members of the Michigan Central line on the Canadian side, at Falls View. I said: "By all means preserve that view for the train." They thought it rather funny, and I said, "More people will travel in trains over that line than ever travel on your roads; by all means let the railroads exhibit to the passengers as many of the beauties of Niagara Falls as possible." We make beautiful railway coaches, do we not? I am interested in this because it seems to be ingrained in the public mind that a railroad is something that is objectionable. I repeat that in principle it is one of the finest things we have; it is simply a matter of treating it properly.

The question of industrial development in Ottawa is a big one. A good many people have the idea that you cannot have industrial development and still keep the city a beautiful place to live in. I think that is another popular fallacy. You cannot have a house without a kitchen, and the kitchen is just as useful and may be just as beautiful as the parlor. But if you put the kitchen stove in the parlor and the piano in the kitchen, you have the mix-up that is characteristic of most of our cities in their civic housekeeping. It is exemplified here just as it is elsewhere. Any professor of physics will tell you that the prevailing winds on the northern half of this continent are from the west and northwest; therefore put your industrial development on the east side of your cities. I tried once or twice to reform the world, but it didn't work as fast as I thought it might. However, perhaps it is a matter of time.

Residential and Industrial City

There is nothing to prevent the development of the capital on perfect lines as a residence city and also on perfect lines as an industrial city, provided each is put in its proper place. You cannot get along without industries; they are the maintenance of life; they are the sinews of life; but they should be put in the right place.

My proposal is that all the industries should be east of the city. Of course, the question of local transportation comes in; there is the question of the canal. I got into the same trouble here a few years ago that I got into at Niagara Falls by telling the Chamber of Commerce this: "I do not know what your opinion of small canals is, but my opinion of the small canal is that anything that will not carry an eight or ten thousand ton boat is an economic absurdity."

The Buffalo papers put a two-column heading over the statement of mine that the Erie canal ought to be turned to account as an irrigation ditch. I don't know whom they were hitting at, but it is a fact that canals are an economic absurdity if they are not deep water canals and cannot carry heavy tonnage.

The Rideau canal is a beautiful streak of water through the city, but it is nothing but an open sewer, and I am in favor of removing it. I would like to see the bed of the canal used for a fast radial railroad, so that people could get from the country into the heart of the city in as few minutes as possible. The average time a man will take to go to his work is half an hour—or perhaps I should say the maximum time, for if he is faced with the alternative of living more than half an hour away from his work he will, as a matter of psychology, accept objectionable conditions in the city rather than do that. So the greater the extent to which you can get your people out of the centre of the city and into the surrounding districts within half an hour, the greater will be the area of land made available for homes.

Reducing the Home's Overhead

The great principle that we are seeking in this matter of town planning is to keep down the capitalization of the home. I believe the time will come when the providing of housing will not be, as it is now, an emergency proposition; I believe that it will be the proper function of civic government to provide houses at cost. In other words, all increment will be cut out. You can tax a man in proportion to the money that he is making, but you should not diminish the efficiency of the home. You should not much tax that which is non-productive; it seems to me that that is plain common sense. You should eliminate all taxation possible from the home.

In many cities in Canada the business area, the earning section, is very much under-assessed as compared with the homes. In fact, any laxity in assessment upon the business or earning propositions is naturally going to be doubled back upon the homes. The tax rate is limited by law, and when they get to the limit and find that they need still greater revenue, they raise the assessment. But assessment should be applicable relatively only to productive sources.

The only source of wealth is production—work; you can't take taxes out of a churn like butter; they have to be produced each year, and if you pound them out of the home you reduce the individual and national efficiency.

There is the question of the plaza, or the civic centre. Personally I favor a large, somewhat triangular centre which would couple up with the parliament grounds and give us a large open space; but the development pictured on the plan, built on great piers, would be rather costly. My proposal is that the through railroad tracks should go down on the west side of the canal to the tunnel under Wellington street south of the post office. In the Commission's plan which was submitted to the government, the tracks go through the bottom of the station, circle through the foundations of the plaza and go into the tunnel at the north side of the post office.

Going on the north side instead of the south side does not affect the post office, but going through under the station and under the plaza, means that you cannot have a clearance for your boats in the canal. A 33-ft. clearance is required, and the proposal involved in this is to start from the third lock and carry that canal through in a great canyon, rebuilding the locks a good deal south of the station. This involves a difference in cost of from two to four million dollars, that is all!—just enough to block an ordinary scheme. A few millions does not count in war time, but when you come to get it from a government or city council in time of peace, it is quite a different matter.

The tunnel proposal, I think, has been accepted by everybody. Those who think that a railroad is objectionable could wish it in no better place than underground, so they could not complain if that were done.

Criticism of Public Buildings

There is the question of the great public buildings here, the parliament buildings. The proposals so far submitted to the government for any disposition of ground along Wellington street do not seem satisfactory; it has been acknowledged that the plans which were earlier submitted were not satisfactory. One thing that I have pointed out is that the heating plant for the new parliament buildings has been placed in the centre of the area previously set aside for the new departmental buildings. Without going into the economics of putting your heating plant 3,000 ft. away from the building which is to be heated, how they are going to disguise the chimney I do not know; personally, I would blow it down without a moment's hesitation. No architect nor anybody else has a right to put his heating plant plunk in the middle of what we had hoped, and understood, to be the site in the future of a great set of departmental buildings. A chimney out of place is not a thing of beauty.

The plans of the proposed public buildings, therefore contain certain things which are not up to date. Those who have studied "sunlight engineering," as it is coming to be called, know that it is essential to health and efficiency that sunlight should penetrate at some time of the day to the base of all walls and into rooms. Here is one of the finest sites in America. Buildings are proposed here with triangular courts to the base of which the sun could not reach by any kink in the zenith. The building that the government recently put up on Queen street—I have been told that it is modelled after something up to date in Chicago or somewhere else—contains a well into which the sun cannot penetrate. This well is said to be 100 by about 50 ft. But the size is not the point; I do not care how big it is; if the sun does not go to the bottom, it is not right.

Sunlight and Office Buildings

I urged in the first place that the building be not put where it is. It was the first public building which had been put up after the submission of the plans and should be in all respects an integral part of a larger plan; and I submitted that if it was not erected on Wellington street it should at least be on Sussex street. That was my first objection; the other point of view was this: I said, "If you will not put the building anywhere else, at least open up the south side of it into a court so that the sun will penetrate into it." They did not do it; they thought it was not economical. I say that in the long run they will find that it is far from being economical to exclude the sunlight. The rays of the sun are the ultimate source of all energy on this planet. The sun is the principle of life, and if you keep it out of your buildings, I care not whether you pave them with marble or roof them with gold like the Buddhist temples, the occupants will suffer.

To the extent that sunlight is excluded, to that extent the people will be less efficient and have less vitality. There are fundamental principles of organic life; you cannot twist them or avoid them by any process of imagination or architecture or engineering or anything else. No up-to-date business enterprise would accept plans excluding sunlight from the buildings proposed to be erected. Why should we in Canada accept in public buildings a condition which is absolutely antediluvian?

Architecture of Parliament Buildings

Another point of discussion in connection with the capital is the question of architecture. Our dominating feature here is the parliament building. Originally it is in Gothic—Victorian Gothic, if you will, but whatever may be its defects that is the keynote that was given to our development. You cannot come along and make your other buildings overshadow or overpower these; if you do, you will subsequently have to replace them for something which will be in harmony—either that, or you are going to spoil your scheme.

I do not mean to say that thirteenth century Gothic should be followed in a departmental building. A Minister of the Crown, discussing the matter with me some years ago, said: "I do not like Gothic. My office is as dark as a tomb; I want some kind of architecture that will give me light." I said: "There is no architecture in the world that involves as little wall space as Gothic, if you take the right kind of Gothic." Because somebody, in the exercise of his judgment—or in his lack of judgment, I should say—chose for office buildings a style of Gothic that has the smallest possible window space, does not mean to say that Gothic is not a good style of architecture for light; it is the greatest light architecture in the world if you get the right style. It is not adaptable for office buildings as a general rule, but it is adaptable for great buildings such as are required for the Senate and the House of Commons.

My criticism of the new buildings is this: Gothic is essentially a development of functional parts joined together. That is what is lacking in our buildings here. The functional parts, like the parts of a great cathedral or an ancient castle, are not expressed. The mildest criticism of the whole thing as a matter of principle is that it is a Renaissance plan with a Gothic shirt—and pockets in the shirt. The proper expression of the spirit of Gothic lies in the expression of the functional properties of the building; you cannot cloud these and still have a good Gothic building. A very fine detail will not redeem a bad plan; that is to say, beautiful Gothic detail will not make a Renaissance building a good Gothic building.

Plan Commission Appointed

A few days ago I saw a copy of an order-in-council which has remedied, in principle at least, a great defect which has existed in respect to the submission of plans for the improvement of Ottawa. Plans are made; sometimes they are accepted and sometimes they are not; but even if they are accepted they are put in a pigeon-hole and left there; and when a man wants to build something which is in contravention of that plan, there is nobody to hit him promptly on the head with a club. That is exactly what happened in the case of the office building that I have referred to; there was nobody whose particular business it was to keep alive the spirit of the plans which had been submitted. This order-in-council names three gentlemen as a commission to look after that very thing: David Ewart, consulting architect to the government; R. C. Wright, chief architect, Public Works Department; and Thomas Adams, town planning adviser to the Commission of Conservation and to the Dominion Cabinet.

I hope, therefore, that we shall make progress towards the preservation and employment of what is good in the

plan; we have now a body to which we can go and make suggestions, and I am sure that they will get a sympathetic hearing. I hope it will be their practice, as it has been the practice in connection with town planning schemes in England, to have public hearings in regard to these matters. You cannot put anything through there without the public having their way. Of course, the representations that are made are not always heeded, but opportunity is given for the ventilation of all grievances, and, after all, that is the safety valve of our democratic system of government.

THE CONTRACTOR'S SALARY AS "OVERHEAD"*

By J. F. Lidral
Of Arvesen & Lidral, General Contractors, Seattle, Wash.

THERE are many among you who have been brought up on construction work since boyhood. There are others among you who have perhaps gone to school to equip yourselves more scientifically for your life's work. In either case you have devoted long years of experience and hard work to place yourselves in a position to be able to accomplish something which the ordinary individual cannot do. You have all the marks of a profession if you will demand from the world that you be considered as professional men.

When a calling is placed in the rank of a profession, the world recognizes that the individual engaged thereip has been qualified by virtue of long study and experience and classes him as an expert who is capable of understanding and undertaking difficult problems. With this recognition comes also the inclination to be willing to compensate him in direct proportion and to the extent that he is able to save time and money for the man who engages him.

You have endeavored to build up your organization and working force. You have saved your money and paid your bills in an attempt to build up your credit standing. Why? So that you are able to perform work better and quicker and buy material cheaper than the outsider or the ordinary layman.

Now, laying aside for the moment the fact that you risk your money and reputation in your business, how much in the nature of a salary are you worth to your firm? Are you working simply for the love of work or are you worth a salary of $100, $200 or $1,000? You hire a foreman and you pay him perhaps $10 a day or approximately $250 a month. This foreman is working for you because he lacks something you possess. Either he does not possess the necessary knowledge to run his own business or his credit is gone or he possesses too much knowledge, knowing that he would be minus his $250 if he figured his worth as do some contractors. The foreman works his eight hours per day and his troubles end.

Forty Hours? Probably Eighty!

There are very few of you who limit your week's work to a minimum of 40 hours for your profession. It is more likely that you are on the job at 7.30 and spend the time until 4.30 racing like mad to keep it going. Then you go to the office until 6, trying to catch up with what you missed during the day. In the evening you have an engagement, here, for example, if you wish, or some party wishes a little free information about a building they never intend to erect, or your car needs adjusting after a hard day's abuse hauling nails and wheelbarrows, or you may go back to the office to work on the books and worry about how you are coming out on that job you took too low. Even Saturdays and Sundays are not exempt for most of you, and I'll wager that the majority of you neglect your families almost entirely. It is safe to assume that you put in more than double the time your foreman does. Is it not logical that each and every one of you is worth at least $500 to your firm? This item is just as much an overhead as is your office rent, interest on the money invested and other items. In other words, to the overhead of every firm should be added a salary for each individual engaged therein.

Some of you may not agree with me perhaps and will make the declaration that a man's compensation should come out of the profit. The definition of business is an undertaking to which risk is attached and which is attempted in order to result in a profit. Your overhead does not and cannot include a probable loss on any job. You lose money as all of you have done at different times. Your profit then is solely the necessary compensation over and above everything else to warrant your assuming the risk involved. In other words it is a bonus over and above your overhead and labor which is rightfully yours for the assumption of the undertaking.

It may be well at this point to make comment on some of the work going on this year. There is at present a noticeable shortage of carpenters and bricklayers. All are employed, indicating that there is considerable work under way. Go along any street of this city and you will see evidence of considerable building activity. How many of you contractors have a job at present that you are satisfied is bringing you all the returns to which you are entitled? There seems to be plenty, and still most of you are marking time waiting for more work to turn up at better prices.

Entitled to Fair Profit

We will take a concrete example: The one-story mill type garages, so many of which are under construction at the present time, with brick walls, concrete floor, tar and gravel roof on trusses and cold water paint on the interior. This is the simplest sort of a job to figure and yet our figures vary 100 per cent. Why? There are no slave-drivers among us nowadays. The workmen will give just about the same amount of work to all of us. Your credit, let us assume, is equally good or at most we cannot underbuy each other more than 10 per cent. There are two reasons. First, you are afraid that the other fellow is going to grab it and you cannot get over the idea that you may make a little spending money if all goes well and you are lucky. Second, you have been influenced by owners and real estate operators who convince you that such buildings have always been and are now being built for 6½ cents a cubic foot. It can't be done. You can't put in brickwork for much less than $40 and 8-in. concrete, including form work, much under $18, so what is the use and why worry about the cheap owners and architects who persuade some uninformed mortal to pack their troubles? I plead with you that in these days of plenty for all of us, you figure to come out on top, allowing for your overhead, a salary for yourself and a fair profit.

In closing, I would like to ask each one of you this question: What do you consider you are worth to the business and professional world, standing apart as one who is an expert? Not until you take enough personal pride in yourself and place a fair price on your labor will the world wake up to the fact that you deserve recognition as an expert and are entitled to a fair compensation for the time, money, experience and energy which you have devoted to your life's work.

*Excerpts from an address before the Seattle Master Builders' Association.

There are only four other communities in the world that have gone a greater distance to secure their water supply than has Winnipeg, Man.

The annual meeting of the Union of Manitoba Municipalities is being held this week in Winnipeg. One of the principal speakers will be J. G. Sullivan, on drainage.

Prominent citizens connected with the Board of Trade of Peterboro, Ont., are advocating the formation of a City Development Commission in order to prepare a plan for that city. Thomas Adams has promised his assistance if the commission be formed. James White, deputy head of the Commission of Conservation, who was in Peterboro recently, is reported as having said that Mr. Adams has been offered $100 a day to go to the United States and plan cities there, and that he feared that the commission would lose Mr. Adams' services.

THE LOGICAL CONTRACTOR*

By William S. Wollner

A CONTRACTOR was asked recently to bid upon a piece of work consisting principally of the erection of a timber truss lift bridge with the necessary foundations and approaches, the total cost of the job being estimated in the vicinity of a quarter of a million dollars. The job seemed a desirable one to the contractor and he carefully prepared his bid which he submitted to his bankers to learn if they would finance the work if he should be the successful bidder. The bankers referred him to their consulting engineer who requested him to leave his figures for a few days so that they might be checked. When the contractor returned for the engineer's decision he was told that while his bid had been carefully and accurately figured it would be useless for him to submit it as there was no chance of his being awarded the work.

The contractor was disappointed and proceeded to display his disappointment in an angry arraignment of the engineer, who also lost control of his temper and instead of explaining the reason for his statement remarked that he could even tell the name of the contractor to whom the work would be awarded. Upon the accuracy of his statement being questioned he named "Smith, Jones & Company" as the firm to whom the work would be awarded and showed the contractor the door. When the bids were opened it was found that Smith, Jones & Company were the lowest bidders for the job, their figure for doing the work being many thousands of dollars less than that of the contractor first mentioned. This man called upon the engineer, apologized for his display of anger, and remarked that if the engineer had told him that he was upon the "inside" he would not have questioned his judgment upon his previous visit. The engineer protested that he was not on the "inside" and proceeded to explain the course of reasoning that had led him to believe that Smith, Jones & Company would be the successful bidders. His explanation ran something like this:—

"In checking over the figures from which your bid was made I found that they took in every contingency that might arise; that you have very properly figured upon the safe side wherever there was a question as to what might be encountered in the course of the work. In your foundation excavation, for example, you figured the cost upon the expectation of encountering rock where there might only be mud and shale, it being of course impossible to determine this under-water condition accurately until the work was under way. Likewise, you figured upon using the extreme length of piling and upon paying the highest scale of wages.

"Another thing that I noticed was that a large proportion of your bid represented the cost of getting your outfit onto and off of the job. You have all the machinery necessary to do the work but it is located far from it and it was necessary for you to figure the freight upon it as well as the cost of getting the equipment to the site of the job and back to the railroad.

Competitors Had Strategical Advantage

"From your point of view you had figured the cost of the job properly. That is, you figured how much it would cost you to actually do the work under the worst conditions that might prevail, with a moderate margin for profit. Having assured myself of the accuracy of your figures from this viewpoint I proceeded to the next question—What would it cost someone else to do the work? In surveying the field I learned that Smith, Jones & Company were the *logical contractors* to do this work. They had done considerable work of a similar nature in the same vicinity and had in fact constructed a bridge for a railroad within a few hundred feet of the proposed structure a few years before. They did not have to back up their guess of what material would be encountered by figuring upon encountering the most difficult to handle; they knew what they would find and where they would find it. Likewise, they knew almost to a foot the length of piling that would be needed.

"Then as to wages; Smith and Jones have been working in this same territory for some years and have built up an efficient organization in which they pay the prevailing scale but from which they get a much larger return in work than you or any other contractor not similarly situated could hope to get. Further, not only do they not have to pay freight on their equipment, but as it is located further up the stream that this structure is to bridge, they have merely to float it down to the site of the work at practically no expense for transportation or loading. As they have work to do in the same vicinity when the job is finished, the cost of removing their outfit will be comparatively small.

"Thus they had the advantage over you or any other contractor who might figure on doing this particular piece of work, and I was practically certain that they would be the successful bidders. Furthermore, as the *logical contractors* for this job it was right that the work should be theirs."

As engineers sometimes become contractors and are often called upon to pass upon the bids of contractors, either as the employee of the contractor or as the engineer of the project, it is important that they understand this theory of the logical contractor. As a contractor or a contractor's engineer he should consider his position with reference to other bidders, and determine whether he is the logical contractor, and if not, whether he is willing to cut down his bid to meet the advantage that the logical contractor possesses. As a project engineer he must be certain to see that the logical contractor is not only given the opportunity to bid but that he is urged to do so in order that the project may have the advantage of the lower bid made possible by his strategic position.

Securing Advantageous Highway Bid

An illustration of how an engineer may reduce the cost of having work done by inducing contractors who are in a position to carry it on at a minimum cost bid for it was given in the recent letting of a county highway job. A road was to be built connecting "A" with "B," the construction cost, according to the engineer's estimate, being divided about evenly between grading and paving. The job was just about big enough to attract bidders from a reasonable distance but not big enough to absorb the cost of transporting a complete grading and paving outfit to and from the work without unduly adding to the expense of building the road. There were only two contractors in the vicinity of the work; one at "A," where he was grading the site for an industry, and the other at "B," where he was placing a concrete and asphalt surface on an old road for the State Highway Commission. Each of these contractors had a complete equipment for the work he was doing but was unprepared to do anything but that. The county ordinance under which the road work was to be done called for bids covering the entire job and it was therefore impossible for either contractor to bid for the portion of the work he was prepared to do.

Realizing that these men were the logical ones to do the work, the county engineer invited them to meet him in his office and pointed out to them the opportunity for combining their outfits and bidding jointly for the work. He pointed out to them that they had an advantage over other bidders in that their equipment was practically upon the job and that their forces were already organized to do the work. Being convinced, they followed his suggestion and filed a joint bid for the job which proved to be considerably less than any other offer and which saved the county a part of the cost of building the road.

Of course this engineer opened the way for charges of favoritism toward these particular contractors, but the fact that he was serving the best interests of his principal was sufficient reason for the course he took. It is the manner in which he handles matters of this kind that makes an engineer valuable or otherwise to his employer and indicates whether he belongs with the common run of untrained and inexperienced men or is entitled to his professional status as an engineer. The dollars and cents side of an engineer's duties may not be the most pleasant feature of his employment, but the working out of the business problems of his projects is an important part of the reason for his employment and will well repay close study and attention.

*From "The Monad."

Letters to the Editor

PRESSURES IN PENSTOCKS CAUSED BY THE GRADUAL CLOSING OF TURBINE GATES

Sir,—I am very much pleased to find that you thought my discussion on water-hammer of sufficient interest to publish it in full in your esteemed paper, issue of September 25th. May I ask you to record the following correction in your next issue, in order to avoid possible misunderstandings:—

Seventh line from top, first column, page 329, "to the area of the gate opening at the time, $t = 0$" should be changed to "to the (assumed) constant area of the penstock, i.e.,

$\psi(t) = (1-t/T)[c_o/(2gy_o)^{1/2}]$."

This mistake was discovered too late to be corrected in the original of my discussion.

EUGENE HALMOS

New York City, November 8th, 1919.

ENGINEERING OPPORTUNITIES IN CHINA

Sir,—"For ways that are dark and tricks that are vain, the heathen Chinee is peculiar." When Bret Harte thus summarized his conception of Chinese character, his estimate and ultimatum were accepted by some millions of "whites" as a final proposition. It ends in a cul-de-sac so far as the average man is concerned, and he is content to mentally add "finis" to things Chinese and direct his attention to other matters and other peoples.

In this attitude he is probably justified if his time is limited or his sphere of activities confined to American or Western European fields. The engineer, however, is not, or should not be, included among those who dismiss the Asiatic with a well-turned phrase and a shrug of indifference. He can learn many things to his advantage from the "yellow race" if he is so inclined and will forget (for the time at least) that he is a superior being, and that he has some centuries of human progress and development behind him which the other has not.

It is generally conceded that China, of the individual "promising fields," offers the largest and broadest scope for development, both commercially and industrially. If this be conceded, it naturally follows that the commercial and industrial activites must be supplemented and, in some cases preceded, by engineering activities involving exploration, study, experience and works. The field is undoubtedly there. The need for the engineer who can visualize and initiate development works is great, but it is imperative that the engineer who intends to share in the development, approach his task with the proper perspective.

Blueprints Are Useless There

China is not virgin territory in the sense that was, or is, Canada, the western states, the African colonies and the South American republics. It is older than the pyramids in race, customs, habits and pursuits. The traditional conservatism of the Englishman is vacillating radicalism when compared to that exhibited by the Chinaman in authority until it is indisputably proven to the Chinaman that it is to his advantage to throw over the old for the new.

Do not try to sell an article or a project to a Chinaman from a blueprint! Show him a photograph; or better still, demonstrate on a small scale, and, if you have adapted your proposition to what he requires or would like, and not to what you think he should have, you have a shrewd but open-minded prospect. Here is a wonderfully inviting field for the young engineer of some experience and undoubted ability who finds his progress blocked or his field overcrowded at home by older men already established.

The mercantile and contracting-engineer concerns of Canada who are looking afield for new business and customers, are awakening to the possibilities in the Far East, but they seem to be overlooking one important element to success. They must have technically-trained men on the ground, as a very few American and British firms have. It is not sufficient to sell a Chinaman or the Chinese government a dredge (for example), send a man over to set it up for operation, and consider the transaction closed. In case of a breakdown or a necessary adjustment for different raw material, an engineer should be easily and quickly available to render the necessary service and advice.

Big Plant Stands Idle

A Chinese company manufacturing hosiery and other knitted wear, was prevailed upon to install two American knitting machines of excellent design and output capacity. A qualified mechanic installed them and remained long enough to see that they were operating. Two weeks after his departure the machines stopped. They were still lying idle two years later when one of the owners, happening to meet a mechanical engineer in Hong Kong, took him home to see the factory. Noticing the discarded machines, the engineer asked permission to set them up again. Three days later they were running to capacity and have continued to do so.

A progressive Chinaman decided to substitute steam for man and animal power in his plant. An over-zealous salesman sold him a boiler and engine generating and delivering five times the amount of power the plant required. It was always too costly, but the war came and coal rose in price and was difficult to get in sufficient quantity. The plant is again run by the original power. The solution of this man's problem lies, not in specifying a smaller power plant, but in utilizing a waterfall quite close to the property to generate both light and power. It is probably not yet too late, but Mr. Canton has a mortal fear of being bitten twice in the same place.

Typical cases could be multiplied, but the sight of a $500,000 dredging plant lying idle in one of the fairly important harbors on the coastline, while some two or three hundred primitive, native dredgers are carrying out a fine piece of harbor deepening and reclamation work nearby, is sufficient demonstration of the fact that governments, as well as individuals, have suffered from a lack of advice from technically trained and experienced engineers.

Pioneer and educational work in developing a market for exports and for securing contracts involves considerable expense at best, but the manufacturer or contractor who supplements his sales efforts by an investment in technical service is building up capital in prestige and good-will. Cognizance is taken of this latter fact at home; why lose sight of it when entering a new field?

Group Export Associations Needed

An adaptation of the "grouping" or "circular" export associations being formed by various American firms, is worthy of serious consideration by members of the Canadian Manufacturers' Association and similar bodies. These groups are composed of a varying number of non-competing houses which combine to form a subsidiary export or trading company. An office is opened in Shanghai or some other of the treaty ports or commercial centres, and the expense is shared by the members according to agreement.

This scheme would seem to be meeting with a satisfactory amount of success, but too much effort has been given to the sales end and too little to the educational, constructional and technical features of the campaigns. Each of these groups should, advisedly, have in its employ a general contractor member, and at least one technically-trained engineer, resident at the foreign office and possessed of initiating ability that will not allow of his becoming a mere travelling mechanic or instrument man.

The number of modern manufacturing plants in existence in China is ridiculously small when the consumer market and the raw materials available are taken into consideration. The number of wealthy Chinamen who are good prospective large-scale manufacturers is much greater than

.s generally supposed on this side of the Pacific. An attractive field for development is suggested by these conditions and admit of almost unlimited expansion if attacked in an aggressive and comprehensive manner.

This view, that the Chinaman should be encouraged to manufacture his own raw materials into consumable products, may be a new one, and it probably will not meet with favor on the part of our importers of these raw materials. It is, however, self-evident that if we supply machinery, building materials and equipment for fabricating the finished products, we benefit in the first instance and the Chinese workman earns money to buy more of our distinctively Canadian exportable commodities. The introductory work suggested is not as difficult as it appears in prospect.

Win Feng, compradore for a Canadian trading company, is in a friendly and intimate business standing with a number of prominent Chinese merchants; among these is Sin Foo, an exporter of hides and skins. It is suggested that it would be more profitable for Mr. Foo to erect a tannery and export leather. The trading company stands ready to supply technical service, plans for the building and plant and, if necessary, will arrange for the supply of a skilled foreman. Mr. Foo, and possibly some of his friends, decide to become manufacturers. Contracts and orders for machinery follow.

The engineer who is included in any organization in the Orient will find that he is continually picking up valuable suggestions in the native processes which will assist his principals in designing buildings and machines peculiarly adapted to local conditions and requirements. In this connection it is suggested that a civil and a mechanical or electrical engineer should be attached to each of the Dominion Trade Commissioners' offices in the Far East.

P. E. DONCASTER,
Public Works Department.
New Westminster, B.C., October 18th, 1919.

MINERAL RESOURCES OF CANADA, WITH SPECIAL REFERENCE TO LIGNITES AND THEIR TREATMENT

Sir,—It is no secret to the well-informed, the observer the reader and the traveller that there are enormous mineral deposits in Canada. These deposits are of the richest kind, and of almost every description. It only requires inventiveness, specialized application and practical knowledge and experience, combined with moderate capital, to produce from these raw materials an abundance of the most essential and now greatly needed commodities to replace the depleted stocks destroyed in the great struggle and to meet the increased demands of the future.

The world is gradually approaching an oil age, an age rapidly approaching, due to the progress made in the development of the internal combustion engine. Ships of every description will be adopting this method of propulsion before many years are passed; the heavy oil engine of the Diesel type will be in common use for marine work. The submersible ship of the future will largely depend upon oil for driving; the motor car, the aeroplane and a thousand other applications of the internal combustion engine are becoming more common daily. Oil will vie with "white coal," of which Canada has such an abundance. The demand for fuel spirit, fuel oil and motor spirit is increasing rapidly, and it will go on increasing.

For years to come the world must practise the strictest economy; everything must yield to the utmost. The great wastes of the past must be abolished, and it is only by conservation and economical utilization of the natural resources that we can recover our stability. Canada is in the finest position to perform a great part in this reconstruction. Its resources are such that it could provide for the needs of a great percentage of the human race. Its mineral wealth is as yet barely glimpsed. One has only to leave the beaten trail for a few miles to see the vast riches of the earth cropping out in every direction. Coal, lignite, oil-bearing shales and oil-bearing sand are the commonest but not the least valuable of our mineral deposits.

Observe the east and the west of the country, where there are limitless measures of the finest bituminous coal, only waiting human genius to wrest vast quantities of oil, spirit, chemicals and fertilizer from these stores of raw material. At present much of man's labor is wasted, especially in the coal fields of the west, where no care is taken to conserve the by-products which represent the most valuable portion of the coal mined. These valuable products are "going up in smoke." Beehive ovens are employed to produce coke for the smelters, ignoring other products.

Consider what underlies the prairie provinces: Billions of tons of the finest lignite. The people of that region need not import fuel if the material which lies beneath their feet is properly treated, and as it can be commercially treated. They need not want for cheap power to develop their industries. They need not regret that they have not the vast water powers of other provinces. Nature has provided for them by giving them these vast stores of buried sunshine, fuel, power, light, heat and many useful by-products besides, such as oil, spirit, gas, fertilizer and chemical bases. All that lignite requires is treatment.

Dormant Wealth East and West

Imagine the dormant wealth lying under the surface of the ground in the maritime provinces—billions of tons of rich oil-bearing shale which, under treatment, would yield per ton of shale an average of 50 gallons of crude oil, 60 lbs. of sulphate of ammonia, and other by-products.

Few people realize the great deposits of oil sand and bitumen lying hidden away in the northwest, but they exist, and only need exploiting. The object of generalizing is to remind the reader that we have these advantages, and that Canada must bestir itself and make development rapidly. Unfortunately the reticence which permeates all governments, is preventing progress. Good men are employed but are bound round with red tape. Capital is offered for development, but is rejected on the grounds that private enterprise and development might result in unhealthy monopoly of common property. Whether the enterprise is private or governmental, it must be made, and made soon. Private development is better than governmental, and it can be controlled by sound legislation. Progress and development of a country means progress and betterment of the people of that country. Let us progress!

The great war has brought out latent powers, sharpened wits, and forced development in many directions. It has brought forward more economical methods and processes for the treatment of raw materials. This is very noticeable in processes dealing with fuels, oils and by-products. J. A. Yeadon, of England, a mining engineer, has for many years been working on a system to carbonize coal and to obtain the by-products from it cheaply and to improve the quality and quantity of same. He has for a number of years experimented with automatic retorts to carbonize coal, oil shale, lignite and other analogous materials at low temperatures. With the assistance of other experts, and chemical engineers, he perfected his system, or process, in the early days of the war.

For years attempts have been made to solve this problem, but with indifferent success, but up to the time of Mr. Yeadon's perfecting his process, no one had been able to make the low temperature carbonization process a commercial success. The retort designed by Mr. Yeadon has solved the difficulty.

Retort for Carbonizing Lignites

This revolving horizontal retort is of special design and construction, with a view to dividing up the charge into fine streams and thus effecting perfect carbonization at a uniform rate, at the same time automatically working the charge through the retort in a continous stream. The speed of carbonization is under perfect control, so that the material need only make one passage through the retort from the point where raw material enters to the point where the carbonized material is extracted. During the progress of the material through the retort, the by-products are extracted in gaseous form. This gas passes up to the hydraulic main, the hydro-carbons are extracted, and from thence it can be used for various purposes. The residuum or car-

bonized material, if coal or lignite, can be turned into fuel for domestic purposes, steam raising, power gas plants, or smelting of ores in blast furnaces, depending on the preparation, which is varied to suit requirements.

The process of coal carbonization can be divided into two distinct systems:—

(a) High temperature carbonization, the chief function of which is to extract the maximum amount of gas for illumination purposes, heating, cooking, etc.

(b) Low temperature carbonization, which is specially adapted to the production of the maximum of by-products, comprising crude oil, sulphate of ammonia, chemical bases and carbon residue.

In speaking of coal, it is meant that shale, cannel, lignite and other analogous materials are included, such as can be treated in a heated retort or other closed vessel for the purpose of producing gas and by-products.

New Low Temperature System

In the high temperature system, notwithstanding the high heat applied, the coal must remain in the retort for a long period—6 to 8 hours—before it is considered to be sufficiently carbonized. Thus it naturally follows that the lower the heat of the retort the longer will be the time required for carbonization, and the smaller the quantity carbonized in a given time in a retort of given dimensions.

These difficulties are further increased in proportion as the smaller sizes of coal are fed into the retort, as these lie "dead." In low temperature carbonization various schemes have been adopted to assist this slow process of carbonization, such as internal shafts, travelling chains, stirrer arms, and other appliances to work inside the retort for the purpose of agitating and stirring up the charge and conveying it through the retort, with a view to getting a more rapid and thorough carbonization. So far these efforts have met with but very indifferent success and have proved of no commercial value.

The invention described in this letter was designed to meet and remedy the aforementioned defects by combining the principle of low temperature carbonization with two other important processes, neither of which had hitherto been worked in conjunction with same.

In the first process the coal is pulverized to a granulated condition, thus allowing the use of the smallest and consequently the cheapest grade, also allowing every particle of coal to come into quick contact with the surface or reflected heat inside the retort, and by this means securing rapid and almost instantaneous carbonization, This necessarily finely granulated condition of the charge is further ensured by drying and partially heating the coal before entering the retort.

In the second process this rapid carbonization is secured by the use of a tapered revolving retort into which the coal is continuously fed at the one end and the carbonized material continuously discharged at the other, both operations done mechanically and automatically."

Automatic Feed and Discharge

The retort is corrugated longitudinally, the corrugations serving a dual purpose: (a) To strengthen the retort body; (b) to increase the internal heating surface; and (c) to agitate the layer of finely granulated coal in its passage through the retort. There are no moving parts inside the retort to give trouble. The charge is fed into the retort by a self-sealed revolving screw feed and is discharged by a similar appliance at the opposite end. The feed and discharge are continuous and automatically controlled without any ingress of air or egress of gas.

The discharged carbon is in an ideal state for being agglomerated with a small proportion of bituminous matter or lime, and converted into block fuel, especially valuable for domestic purposes or for manufacturing uses. The fuel is practically smokeless.

The retort can be heated by part of the gas produced in it.

Labor is reduced to a minimum, and no skilled attention is necessary to operate the retort bench. The capacity of the retort is very great and much exceeds any other form of carbonizer, gas works retort or coke oven. The product is more uniform in quality, whether gas, oil or carbon is the objective.

A great feature in favor of this type of retort over the coke oven is the ease with which the plant can be increased without disturbing the existing plant, its great capacity for producing a large amount of the highest quality of blast furnace fuel at a low cost, and the continuous process of manufacture.

As a smelting fuel, the carbon is superior to coke. The granulated carbon is turned into blocks of 20 lbs. weight very cheaply, and in this form it is strong and capable of carrying a very heavy "burden." It takes up a position in the furnace which tends to produce perfect combustion, admitting of the blasts having a free course, and thus producing a more uniform heat throughout the furnace, and reducing the amount of fuel per ton of ore smelted.

This fuel is almost pure carbon; it has no equal for open fires or closed furnaces. It is practically smokeless, whether made from bituminous coal or lignite, and the calorific value is greater, weight for weight, than the raw material.

In the manufacture of smelting fuel, the agglomerate may be hydrated lime, whilst in the manufacture of domestic fuel, very little agglomerate is required if the retort works in direct conjunction with the press. If agglomerant has to be used, it may be the pitch produced from the carbonization, or tar, sulphite pitch or the residuum from oil refineries, or a mixture of the two latter. It depends entirely on local conditions and circumstances.

Says Private Capital Is Available

The carbon makes an excellent fuel for producer gas plants, and in this connection a good yield of sulphate of ammonia is obtained. The volume of good, clean gas of first-class quality is very great. The retort can be adapted to producing gas for domestic use and its adoption places within the reach of every small town a public supply of gas for heating and lighting purposes.

Canada has the raw material; it wants only brains and money to exploit them. There is no dearth of brains, experience and practical knowledge, and the capital is forthcoming providing that the owners have the co-operation and protection of the government. In other words, let the provincial governments grant concessions for the development of these resources by private capital and by men who know how to do it; it is not amateurs' work. Resources, men and money are available and waiting to develop Canada.

WILLIAM ARMSTRONG.

Montreal, November 4th, 1919.

The Ontario Section of the American Society of Mechanical Engineers held its first meeting of this season last Friday evening. The season's work was discussed, and it was decided to hold one meeting per month, the meetings to be alternately a technical session and a dinner with an address. Members of the society came from as far as Chatham, London and Belleville to attend last Friday's dinner, and it was felt that this indicated that considerable interest would be taken in the work this season. After the dinner, which was held at the Engineers' Club, Toronto, Brig.-Gen. C. H. Mitchell delivered an address upon some phases of mechanical engineering which had come under his observation in France and Italy during the war. He particularly covered transportation and the mobile shops in the advanced areas in France. He made some interesting observations regarding Italian hydro-electric power developments as he found them at the end of the war in comparison with their condition and size in 1906. He also gave a vivid description of the Italian engineering feats in the construction of the "teleferrica," or wire cableways, which transported munitions and men in hanging carriers over mountainous peaks and across great chasms even when subject to heavy shell fire.

PROBLEMS AFFECTING DESIGN AND CONSTRUCTION OF HIGHWAYS*

By W. G. Thompson
State Highway Engineer of New Jersey

IT has been said by a well-known railroad executive that the railroad of the future may find it more economical to tear up short-line tracks and develop motor truck transportation in their place. Although the supplying of tonnage is the freight traffic manager's problem, it is also a problem which should engage the serious attention of the engineering department, from the viewpoint that every means should be employed to reduce the cost of supplying tonnage to the main lines, just as careful attention is given in location and construction, to reducing grades and curvature to the minimum. It is claimed that, considered as a unit, few branch lines pay expenses, but as gatherers of freight and passengers to increase density of main-line traffic, they are sources of profit. As, however, traffic gathered by them is turned over to the main lines with a deficit attached, which has to be overcome during the main-line movement before any profit is made, it might be a decided advantage if this traffic could be delivered to the trunk line by means of the motor truck or tractor, without this bill of expense attached.

May Eliminate One Handling

Since it is a fact that it is now necessary to truck products of all kinds, and especially farm products, to the short branch line, and load them into cars, a serious investigation of the matter may disclose that one handling might be obviated and considerable expense saved if the tracks were removed from many branch lines and the grade used for an improved motor road, which could be entered from every intersecting highway. Such an arrangement would mean increased facilities at main-line points for freight handling, but with the present rapid improvement of country and interurban highways, it would relieve the railroads of the burden of maintaining freight stations, water systems, coaling stations, track and other structures, and the inevitable overhead expense during seasons when traffic is light.

It is inconceivable that trunk highways paralleling trunk lines of railroads will ever seriously affect the tonnage carried by the railroads, but it is quite conceivable that with the extensive building of hard, smooth, all-year highways, the tonnage of branch line roads will be very seriously affected, and in my opinion this problem should from now on engage the attention and induce careful investigation by the engineering departments of railroads, whose managers are looking to the future and the economical handling and transportation of freight.

There are, at present, approximately 6,000,000 passenger motor cars in the United States. Conservative estimates place the passenger mileage of automobiles in the United States at 45,000,000,000 per annum. Commercial motor cars increased from 60,000 in 1912 to approximately 600,000 in 1918. The mileage for all kinds of commercial motor cars is now estimated at 5,000,000,000 ton-miles per year. It is estimated there will be in use at the end of the next 10 years 20,000,000 passenger and 5,000,000 commercial motor cars. Surely the above figures should cause railroad officials more than casual concern and lead to consideration of the matter of short-line hauls from the highway viewpoint.

Same Principles of Design

Highway engineering to-day differs little from railway engineering. The same fundamental principles are involved in the original design of both—viz.: Alignment, grades, curves, drainage of subgrade, bridges, superelevation of curves, etc. There must also be traffic regulations and signals, danger signs, distance and direction markers, etc. Particular attention is being given to grades and curves, especially on the New Jersey state highway system, where, except in very hilly country, 5 per cent. grades and 6 deg. curves are the maximum.

*From an address before the New York Chapter of the American Association of Engineers.

The advent of the swiftly moving motor vehicle soon demonstrated that the earth and macadam pavements were unsuitable and uneconomical for that class of traffic, therefore the most durable types such as concrete, stone block, asphalt and brick pavements are now being laid. Light foundations and inadequate drainage are the most fruitful causes of pavement failure, as they are in track construction. Systems should be provided for thorough drainage of the sub-foundation, such as lateral drains under the pavement, leading to longitudinal drains; the construction of storm sewers on a grade in long, level sections; and the construction of side ditches and gutters. In the preparation of sub-foundation, all areas of permanent saturation are removed and replaced with coarse sand or broken stone placed directly beneath the pavement. Experience is developing the fact that concrete provides the most durable and lasting foundation under heavy traffic. It is being used in rapidly increasing amount as a pavement and as a foundation for other types of pavement.

Widths, Thicknesses, Curves, etc.

On country and interurban highways, graded widths from gutter to gutter are not less than 30 ft. and the hard pavement not less than 18 ft., widening to 24 to 30 ft. where several roads converge, or when approaching large cities. All curves exceeding 3 degs. are superelevated, as in railroad practice, in accordance with a formula devised for the purpose and based on a speed of 30 miles per hour, though some of our banked curves have been driven at 60 miles per hour, presumably because the driver liked the sensation of rounding a curve at high speed without the effort of resisting the overturning force.

Laws of most eastern states permit gross loads of from 24,000 to 30,000 lbs. on trucks, therefore bridges are being designed for 20-ton loads, assuming 75% of the load as being on the rear axle.

Rapid increase in use of motor vehicles makes pertinent the question as to whether we are building pavements sufficiently wide and foundations sufficiently heavy. The first is a matter of local finances; the second is one which can be determined only by experience and observation, extended over a period of years. On our most heavily traveled route, that between Newark and Trenton, we are laying a concrete pavement 8 ins. thick at the sides and 10½ ins. at the centre. On all other routes the pavement is being laid 6 ins. at the sides and 8¾ ins. at the centre. It is believed these will suffice for 15 or 20 years.

Public Service Conditions Changing

A comprehensive system of marking the highways with danger, distance and direction markers is being installed to enable the motorist to travel from place to place with convenience and safety, if he will but observe the traffic regulations and ordinary courtesy to others.

Highway and highway transportation engineering offer a broad, promising field to young engineers in the future. There are objections to employment in public service, the principal one being uncertain tenure of office, due to changing political administrations, but it is within the power of the engineers of this continent, by united and persistent effort, by educational propaganda, the exercise of tact, good judgment and constant adherence to the high ideals which actuate 99% of our engineers, to so mould public opinion that within a very few years the civil engineer may attain the social and economic status which is rightfully his, especially in the administration of public business and affairs. To most engineers, the idea of mixing or entering into politics is repugnant, but the present political system and the appointment and election of misfits and unfits will continue until the people of this great nation are educated to demand trained, experienced, practical men for the conduct of public affairs.

W. B. Redfern, 84 Close Ave., Toronto (Telephone Adelaide 2938), desires a copy of the November 9th, 1911, issue of *The Canadian Engineer*. Some subscriber may be able to oblige.

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METHODS OF PUMPING IN ONTARIO

ACCORDING to a private report recently made by an engineer who had investigated the water works and fire protection systems of practically all the municipalities of Ontario, three-quarters of the municipalities depend for their water pressure upon steam only, electric power only, gravity only or a combination of steam and electric power. No less than 43 municipalities out of a total of 171 (or 25%) last year had facilities for pumping by steam only; while 39 (or 22.8%) had both steam and electric pumping; and 27 (or 15.8%) pumped by electric power only; 18 municipalities (or 10.5%) having gravity systems. The following table indicates comparatively little change in the situation since 1916:—

NUMBER OF MUNICIPALITIES IN ONTARIO, IN YEARS 1916-8, HAVING WATER SUPPLY AND FIRE PROTECTION SYSTEMS, AND KIND OF POWER UPON WHICH THE PRESSURE DEPENDED

	1918	1917	1916
Steam only	43	46	50
Water power only	6	7	8
Electric only	27	23	24
Gas* only	9	8	9
Gravity only	18	17	16
Steam and water power	5	5	4
Steam and electric	39	43	39
Steam and gas*	2	3	2
Steam, water power and electric	1	0	0
Steam, electric and gas*	1	0	0
Water power and electric	8	7	7
Water power and gas*	1	1	1
Electric and gas*	11	8	8
Total	171	168	168

*Gas, gasoline or oil.

STRAIT OF BELLE ISLE DAM

REFERENCE was made in a recent issue of *The Canadian Engineer* to a daily newspaper dispatch stating that "the climate of Newfoundland would be changed if a breakwater were built across the strait of Belle Isle, between the island and the mainland, and the cold Labrador current shunted out into the Atlantic Ocean.

"Such a dam is being seriously considered," continued the newspaper article. "It would cost an immense sum of money, but engineers say it presents few difficulties. The Labrador current, at present, is the chief factor in moulding the climate, not only of Newfoundland, but of the Maritime Provinces and New England. Coming down from the Arctic Ocean, it pours through the strait of Belle Isle, and, circulating around the gulf of St. Lawrence, washes with its cold flood the coasts of Newfoundland, Quebec, New Brunswick and Nova Scotia."

James White, deputy head of the Commission of Conservation, Ottawa, calls our attention to the fact that the strait of Belle Isle, at its narrowest point, is 11 miles wide, and that it has a maximum depth of 330 feet and an average depth of 215 feet.

Ignoring such "details," moreover, there is the further drawback that the Labrador current does not "pour through the strait" and does not wash with its cold flood the coasts of our Maritime Provinces. Several years ago Dr. W. Bell Dawson, superintendent of Tidal and Current Surveys, ascertained beyond doubt that such current as there is, ebbs and flows with the tide, and does not set through the strait, either from the east or from the west.

PULVERIZED FUEL

THE Commission of Conservation has just issued a report on "Pulverized Fuel: Its Use and Possibilities," by W. J. Dick, which may be had on request by those interested in economy of fuel for power and large heating plants.

One of the pressing problems of industry in Canada is that of fuel supply. This is especially the case in manufacturing processes requiring heat. The rising costs of coal and the difficulty of transportation have proved handicaps of considerable importance, and are rapidly becoming accentuated. This situation demands that all the available heat contained in the coal be made use of. In the utilization of run-of-mine coal, a large proportion is lost in the form of cinders and clinkers. To overcome this waste, a process for using coal in pulverized form is now in successful use.

Under this process the coal is first dried to reduce the moisture content to approximately 1%. It must then be ground until 95% will pass through a 100-mesh screen and 85% through a 200-mesh screen. The coal is then transferred, usually by screw conveyors, to the furnace supply, whence it is blown into the fire-box by means of compressed air. Consumed in this way, the coal burns like a gas and the flame has the characteristics and appearance of a gas flame. Results of tests have shown that there is no formation of slag in the furnace or on the tubes, there is no shower of cinders or ashes emitted from the smokestack, and there is no damage done the boilers from heavy overload conditions.

Canada is particularly interested in the use of pulverized coal. At the pit-head and underground at the mines in Nova Scotia and British Columbia are great piles of unmarketable coal dust and slack, while in Alberta and Saskatchewan there are immense reserves of lignite which is high in moisture content. This lignite rapidly disintegrates on evaporation of the moisture, and, consequently, will not stand transportation. It is also unsuitable for locomotive fuel on account of its liability to start fires from excessive sparking. But these coals, by drying and pulverizing, make excellent fuels for either heating or power-development purposes. They are lower in price, less expensive to handle and give greater heating value. The Dominion Coal Co., at New Waterford, N.S.; the International Nickel Co., at Copper Cliff, Ont.; the

British Columbia Sugar Refining Co., at Vancouver; and, with one exception, all the cement companies in Canada, are using pulverized coal with very satisfactory results.

PERSONALS

LEWIS W. WYNNE-ROBERTS, who has just returned to Canada after three years' military service in India and Mesopotamia, was born November 14th, 1891, in Carnarvon, Wales. His father is R. O. Wynne-Roberts, consulting engineer, Toronto, who went to South Africa in 1898 as city engineer of Capetown. Consequently L. W. Wynne-Roberts received his primary education at the South African College School in Capetown, subsequently studying engineering at the Day Technical College, University of London, Eng., where he was a gold medallist and graduated with honors in 1912. Shortly after his graduation he followed his father to Canada and joined the staff of the Provincial Board of Highway Commissioners at Regina, Sask., as assistant engineer on design of concrete bridges.

Among other work, he assisted in the design of the Saskatoon bridge, one of the largest and most notable of its kind in Canada. In October, 1915, he resigned from the staff of the Highway Board in order to go to England for the purpose of enlisting in the army. He obtained a commission as lieutenant in the Royal Engineers; and in the fall of 1916 was sent to India, where he was loaned to the Indian government and became engineering instructor to British officers who were connected with the 2nd Sappers and Miners of Bangalore. After six months of this work, he requested a more active post and was sent to Mesopotamia with reinforcements for a field company of engineers. In Mesopotamia Mr. Wynne-Roberts was engaged under Generals Maude and Marshall in general field engineering work, including water supply, bridges, demolition work, etc. In July, 1918, he was promoted to the rank of captain and was sent to Northern Persia as one of a party of five engineers who were entrusted with the contruction of a water-bound macadam road from Ruz to Hamadan, a distance of 370 miles This road formed a part of the Bagdad to Baku route and was necessary for the transportation of supplies to the British force operating in the vicinity of the Caspian Sea. The five engineers divided the work and each had less than 10 weeks in which to make passable over 50 miles of highway solely with the aid of native labor and without any machinery or tools excepting those made for them in the Persian bazaars. The entire route had been impassable the previous spring, and there were also a large number of antediluvian bridges that needed repair in order to carry the army's motor trucks. The stone for the repair of the road was broken with sledges by women and children and carried to the job in bags on the backs of donkeys, in some cases for a distance of 6 miles. These animals also transported the water in old kerosene oil cans. Mr. Wynne-Roberts left Persia in April of this year but upon his arrival in India was sent to the Afghanistan frontier for several months and was unable to sail to England until August. He was released from military duties upon his arrival in England and landed in Halifax two weeks ago.

L. D. WALKER, of Ottawa, has received an appointment on the Welland Ship Canal engineering staff.

W. S. ATWOOD and A. D. NEALE have been appointed vice-presidents of the Canadian Car and Foundry Co., Ltd., Montreal.

H. H. VAUGHAN, general manager of the Dominion Bridge Co., Ltd., Montreal, has resigned in order to devote his attention to other interests.

W. F. MCKNIGHT, sales manager of the wire and cable department, Northern Electric Co., Ltd., Toronto, has been transferred to the head office at Montreal and has been appointed educational director for the company.

S. L. SQUIRE, of Toronto, and GEO. A. MCNAMEE, of Montreal, who are respectively president and secretary of the Canadian Good Roads Association, expect to visit Winnipeg at an early date in order to arrange the details of the annual convention which will be held in that city next May.

C. A. MAGRATH, of Ottawa, chairman of the Canadian section of the International Joint Commission, has been reappointed to the office of Dominion Fuel Controller in view of the serious situation that has arisen in regard to the importation of bituminous coal from the United States, due to labor troubles in that country.

OBITUARY

JOSEPH A. DOWNEY, contractor, Toronto, died last Saturday, at the age of 45. The late Mr. Downey was born in Dixie, Ont., but entered contracting work in Toronto when he was 20 years of age.

TOWN PLANNING CONFERENCE AT HAMILTON

THE preliminary program for the third annual Town Planning Conference of South-Western Ontario, which is to be held next Thursday and Friday in Hamilton, Ontario, includes suggestions for discussion on the following proposed legislation: Power to adopt a town planning scheme with suitable regulations for housing, sanitation, height of buildings, width of streets, etc., and for establishing zones for industrial, commercial and residential purposes; the formation of town planning commissions on which city councils are to be represented, these commissions to have their powers limited by having to submit to the city councils any schemes involving large expenditures; power to provide for gradual and economical street widening in congested areas by fixing a building line; reasonable limitation of damages claimed on account of town planning schemes, and permission for town planning commissions to share in increased values caused by the carrying out of their schemes; permission to buy, own and sell land other than that actually required by town planning commissions, such purchase to be for the purpose of profiting by the increased values caused by the carrying out of the schemes, thus assisting in paying for same; power to co-operate with suburban areas in developing along lines consistent with mutual interests. Other discussions will be on housing problems in the United States and Canada, municipal government and reconstruction, legislation and town planning, beauty and health in relation to town planning, town planning in relation to industrial development, zoning, and the question of whether town planning is profitable. The speakers at the conference will include Lawrence Veiller, Dr. Horace L. Brittain, S. Baker, J. A. Ellis, Sir John Willison, Thomas Adams, Noulan Cauchon, Mrs. Dr. S. Lyle, C. A. Kirkpatrick, and W. J. Donald.

J. C. Davies, managing director, and Roger Beck, director, of Baldwin's, Ltd., Swansea, Wales, are in Toronto to supervise the initial operations of Baldwin's Canadian Steel Corporation, Ltd.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand or proposed, contracts awarded, changes in staffs, etc.

ADDITIONAL TENDERS PENDING

Not Including Those Reported in This Issue

Further information may be had from the issues of *The Canadian Engineer*, to which reference is made.

PLACE OF WORK	TENDERS CLOSE	ISSUE OF	PAGE
Biggar, Sask., erection of Nurses' Home and Isolation Hospital	Nov. 28.	Nov. 13.	46
Erickson, B.C., erection of highway bridge	Nov. 25.	Nov. 13.	44
Montreal, Que., briquetting machinery	Dec. 14.	Nov. 6.	54
Ottawa, Ont., supply of eleven pontoon discharge pipes for dredge "P.W.D. No. 5"	Nov. 26.	Nov. 13.	52
Powell River, B.C., dredging	Nov. 25.	Nov. 13.	52
Sandwich and Ojibway, Ont., completing south sewage interceptor	Nov. 27.	Nov. 13.	45
Toronto, Ont., construction of asphalt pavements, concrete curbings and concrete sidewalks	Nov. 25.	Nov. 13.	44
Windsor, Ont., erection of school	Nov. 29.	Nov. 13.	50
Winnipeg, Man., six 1,000 k.v.a. step-down single-phase transformers	Dec. 1.	Nov. 13.	45

BRIDGES, ROADS AND STREETS

Brandon, Man.—Brandon will probably link up with Crystal City in a good roads scheme, the city council having received a letter from F. H. Barnard, secretary of the Sunshine Highway, recommending this action being taken. The matter has been referred to the Good Roads Committee of the city council.

Carstairs, Alta.—Town council plans construction of concrete walks. Cement mixer may be purchased. Secretary-treasurer, L. Aldrich.

Chippawa, Ont.—Tenders, addressed to Sir Adam Beck, Chairman, Hydro-Electric Power Commission of Ontario, 190 University Ave., Toronto, will be received until 12 o'clock noon, November 28th, 1919, for the construction of the Chippawa Highway Bridge. Plans and specifications may be obtained from the chief engineer.

Hull, Que.—City council plans erection of bridge. Engineer, J. P. A. Laforest.

Kingston, Ont.—City council passed a by-law for the construction next spring of a bituminous pavement on a new macadam base on Nelson St., from Princess to Johnson. City engineer, R. J. McClelland.

Millardville, B.C.—Repairs to the Clarke Rd., which connects Port Moody and New Westminster, will be commenced in the near future. Repairs will also be made to the Brunette River bridge.

Niagara Falls, Ont.—The C.P.R. has surveyed a line from the north of Welland city, touching the boulevard about one and a half miles above Black Creek, where an international bridge will be built, crossing the river to Buffalo. It is supposed that the bridge will be built to carry electric cars and other vehicular traffic. According to the estimates, the bridge will be the last word in engineering.

Quebec, Que.—The private secretary to the Minister of Roads states that while Quebec's highway work will be continued along the same construction lines as in the past, there is no definite plan at present of spending many millions of dollars as recently reported or of building as much as 6,000 miles of roads next season.

Simcoe, Ont.—Plans for construction of five bridges are being prepared by G. R. Marston, engineer.

St. Athanase de Bleury, Que.—Tenders will shortly be called for construction of gravel road. Engineer, M. Henry, Roads Department, Parliament Buildings, Quebec

Ste. Cecil de Whitton, Que.—Tenders will shortly be called for gravelling road at cost of $85,000 for municipality of North Whitton. Engineer, M. Henry, Roads Department, Parliament Buildings, Quebec.

St. John, N.B.—Plans and specifications will be prepared for the paving of Douglas Ave., City Road, Brussels St., and Marsh Road, the work to be done by contract. City engineer, G. N. Hatfield.

St. Pamphile, Que.—Tenders will shortly be called by municipal council for construction of steel bridge. Engineer, Ivan Vallee, Public Works Department, Parliament Buildings, Quebec.

Three Rivers, Que.—Plans prepared for railroad bridge for C.P.R., Montreal. Cost, $50,000. Engineer, W. B. Harper.

Toronto, Ont.—Board of Control let contract to the London Concrete Machinery Co., Ltd., London, Ont., for one No. 4 special concrete mixer with 3 h.p. Novo gasoline engine.

Toronto, Ont.—Works committee recommended adoption of Works Commissioner's report for the grading of Stacy St., Coxwell Ave. to Drayton Ave. Estimated cost, $4,685. Also grading of Hillingdon Ave., Hanson St. to Danforth Ave., cost, $4,920.

Toronto, Ont.—The plan to extend University Ave. through from Queen St. to Front St. was adversely reported on by Finance Commissioner Bradshaw, Works Commissioner R. C. Harris and Assessment Commissioner Forman at a recent meeting of the Board of Control. The officials estimated that the project would be too costly. They favored an alternative plan for a new street midway between York and Bay Sts., from Queen to Front. The work, however, will not be undertaken at present owing to the general financial situation. However, the Board of Trade will hold a conference with regard to University Ave. extension plan.

Toronto, Ont.—Board of Control let contract for the construction of concrete curbing on Bristol Ave., to the Con-

TENDERS WANTED

Sealed tenders will be received by the undersigned, addressed to Chas. G. Booker Esq., Mayor, Chairman, Board of Control, City Hall, Hamilton, up to 5 o'clock p.m., on Monday, December 1st, 1919, for the manufacture of 1,994 lineal feet of 33-inch diameter Reinforced Concrete Pipe.

Tenders must be on forms supplied and plainly marked on the outside as to contents.

Specifications and form of tender for the above can be obtained at the office of the City Engineer, where any other information may be secured.

The lowest or any tender not necessarily accepted.

S. H. KENT,
City Clerk.

Hamilton, November 19th, 1919. 380

structing and Paving Co., Ltd., Confederation Life Chambers, Toronto, at 78c. per lineal ft.

Toronto, Ont.—Board of Control awarded contracts to R. C. Harris, Commissioner of Works for the construction of the following asphalt pavements: Bristol Ave., price, $9,-908; Herman Ave., $3,379; Hiawatha Road, $13,926; Sackville St., $11,257. Also for granite block pavement on Eastern Ave., from St. Lawrence St. to Broadview Ave., $37,-440.

Toronto, Ont.—The Board of Control recommended that the construction of the undermentioned local improvement works, authorized to be carried out by day labor, be transferred from the Commissioner of Works to the contractors named at the estimates submitted by the Commissioner of Works, as follows: Bitulithic pavement on Exeter Ave., from Laughton Ave. to the east end, to the Warren Bituminous Paving Co., McKinnon Bldg., Toronto, price $5,871; concrete sidewalk on Erie Terrace, e.s., from Queen St. to Gerrard St., to the Ramsay Contracting Co., 39 Indian Rd., Toronto, at $2.23 per lineal foot., to the Godson Contracting Co., Manning Chambers, Toronto; asphalt pavements on Kenilworth Ave., from Queen St. to 200 ft. north, price $3,157; Alvin Ave., from Heath St. E., to Glen Elm Ave., $4,959; Don Crest Road, from Third St. to Ozark Crescent, $7,661; Weston Road, $3,481.

Toronto, Ont.—Works Committee recommended the adoption of the Commissioner of Works' report for the construction of an asphalt pavement on Gerrard St., from Main St. to east city limits, at a probable cost of $182,441; asphalt pavement on Swanwick Ave., Main St. to Pickering Ave., cost, $36,720; bitulithic pavement on Edna Ave., Indian Road to Indian Grove, cost, $7,520; asphalt pavement on Crown Park Road, cost, $6,609.

Victoria, B.C.—City Engineer F. M. Preston submitted a report to the city council, recommending the preparation of a by-law authorizing the construction of the Johnson St. bridge on the basis of a city-owned structure for vehicular, pedestrian and street car traffic, costing in the neighborhood of $420,000.

Winnipeg, Man.—Tenders will be called by the Dominion government for construction of roads and sidewalks for military hospital. Plans with H. E. Matthews, Lindsay Building.

Winnipeg, Man.—The works committee's recommendation that $46,417 worth of improvements be proceeded with was passed by the city council. The works include a 24-foot asphalt pavement on River Ave., from Main to Osborne Sts. at a cost of $43,237. City engineer, W. P. Brereton.

WATER, SEWAGE AND REFUSE

Assiniboia, Man.—Contract for laying water main let to Dominion Construction Co., Winnipeg, and for sewer to Fowler & Young. Total estimated cost, $21,000.

Brooke Tp., Ont.—Township council plans construction of drain. Clerk, W. J. Weed, Inwood, Ont.

Chatham Ont.—The E. A. James Co., Ltd., engineers, 36 Toronto St., Toronto, who were consulted by the city to solve Chatham's water problem, have recommended to the water commission that the city should undertake a new waterworks scheme with Lake Erie as the source of supply. The report estimates the cost of such a scheme at $600,000. The water would be pumped to Erie Ridge, and flow by gravity to the city nearly 13 miles. The engineers were instructed to investigate the River Thames, the Snye Carte, and the lake as feasible sources of supply. The engineers estimate the cost of the Snye scheme at $700,000, and the Thames, $300,000. W. H. Westman, chairman of the water commission also favored the Lake Erie scheme. The three propositions will be submitted to the electors to decide upon at the municipal elections in January.

Crowland Tp., Ont.—Tenders will be received up to December 18th by H. L. Pratt, township clerk, Welland, Ont., for the excavating and laying of water mains in the Welland South district. Plans and specifications may be seen at the clerk's office, police station, Welland.

Elma and Blanshard Tps., Ont.—Plans for the construction of drains for Blanshard and Elma townships are being prepared by John Rogers, engineer, Mitchell. Tenders will be called.

Hamilton, Ont.—Tenders, addressed to Chas. G. Booker, mayor, chairman, Board of Control, City Hall, will be received by S. H. Kent, city clerk, up to 5 o'clock p.m., on Monday, December 1st, 1919, for the manufacture of 1,994 lineal feet of 33-inch diameter reinforced concrete pipe. Specifications may be obtained at the office of the city engineer.

Kitchener, Ont.—Water Commissioners decided to lay a 4-inch main on Onward Ave.

Logan Tp., Ont.—Tenders will be received by L. G. Rock, clerk, R.R. No. 1, Bornholm, Ont., until November 24th, for the construction of the Nicholson drain. Plans at clerk's office.

Milverton, Ont.—The town council have employed the E. A. James Co., Ltd., consulting engineers, Toronto, to prepare plans and specifications for complete water works installation. The plans contemplate deep wells, stand pipe, mains, together with electric pumping plant.

Montreal, Que.—The sum of $8,000 has been voted by the Administrative Commission for repairing a broken sewer in St. James St, between Richmond and St. Martin. It is estimated that 425 feet of the sewer will require to be renewed.

North Bay, Ont.—Town council is considering the construction of a water main on Fourth Ave. Town engineer, H. J. McAuslan.

Plympton Tp., Ont.—Plans and estimates for construction of drain are being prepared. Clerk, Thos. Nisbet, Wyoming, Ont.

Raymond, Alta.—The Southern Irrigation district, consisting of the lands tributary to Raymond, Magrath and Stirling, will, within the course of a few weeks be created into an irrigation district. At a special meeting held recently, attended by representatives from all these towns, the matter of organization was discussed, Hon. A. J. MacLean, Minister of Public Works, has advised the organization of the district.

South Vancouver, B.C.—Five tenders were received for ditch construction in the Collingwood East district as follows: $28,700, $18,000, $18,650, $14,343 and $14,343. The lowest, that of A. J. McDonald, of Vancouver, was accepted. The contract includes a monolithic sewer, 32,060 ft., and a 12-in. pipe sewer on Kerr Rd.

St. Thomas, Ont.—Ald. Curtis, Chairman Board of Works, will prepare plans for tile drain and septic tank.

Toronto, Ont.—Works committee recommended adoption of Commissioner of Works' report for construction of sewers on McKinley Ave. at probable cost of $8,480, and on Blake St. at cost of $7,630.

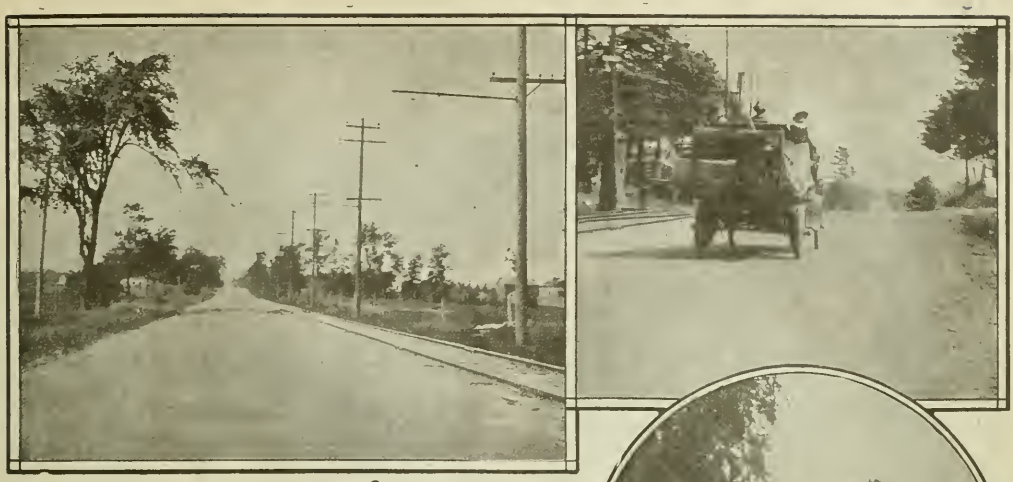
Toronto, Ont.—Board of Control let contract for an overflow storm sewer on College St. to John Maguire, Toronto. It is an $82,000 contract, and Mr. Maguire's tender was $140 higher than that of the lowest tenderer, W. C. Brennan, of Hamilton.

Toronto, Ont.—Board of Control let following contracts for construction of brick storm overflow sewers: College St., Beatrice St. to Palmerston Ave., to T. C. Agnew, 350 Concord Ave., Toronto, price, $35.50 per lineal foot; College St., Palmerston Ave. to Spadina Ave., to John Maguire, 265 Russell Hill Road, Toronto, $28.85 per lineal foot.

LIGHT, HEAT AND POWER

Hampton, N.B.—Town council plans installation of electric light plant. Cost, $18,000. Clerk, A. W. Hicks.

Lloydminster, Sask.—Contract let to Stewart & McPhee by town council for installation of electric light and power machinery.



Three views of Tarvia-filled macadam roads in County of York, Ont. Built with "Tarvia X" 1917, Toronto and York Roads Commission.

County of York (Ont.) Highways—Built and Maintained with Tarvia

THE highways shown in the three photographs are splendid examples of Tarvia roads.

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The photographs were taken more than a year later. Note the excellent condition of the roads—the smooth, firm, easy traction surface.

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Using Tarvia for a binder makes a road waterproof and frost-proof, and for that reason Tarvia construction is particularly suited to the requirements of the roads of the Dominion which must be able to come through the severe Canadian winters without damage.

Experience has proved that Tarvia does away with the extensive spring repairs that untreated roads nearly always need after a hard winter.

Indeed, Tarvia proves to be a good investment of the taxpayer's money, not an expense, for in the long run Tarvia *pays for itself in lower maintenance cost.*

For instance, an occasional Tarvia treatment will keep these County of York highways mudless and dustless, and in fine condition indefinitely at very small cost.

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Preserves Roads-Prevents Dust

Special Service Department

This company has a corps of trained engineers and chemists who have given years of study to modern road problems. The advice of these men may be had for the asking by anyone interested.

If you will write to the nearest office regarding road problems and conditions in your vicinity, the matter will be given prompt attention.

MONTREAL TORONTO WINNIPEG VANCOUVER

The Barrett Company LIMITED

ST. JOHN, N.B. HALIFAX, N.S. SYDNEY, N.S.

Winnipeg, Man.—Officials of the Bruce Consolidated Mining Co. are investigating cost of construction of a power line into the Rice Lake district.

Winnipeg, Man.—Work on a new 110,000-volt transmission cable, to run from the Winnipeg power plant at Point du Bois, Man., parallel to the present cable, will be started immediately and completed before November, 1920, according to an announcement made by J. G. Glassco, manager of the city power and light department. The new line will cost the city $750,000. Extension to the city office, 54 King St., and to the power plant on the Winnipeg River will bring the total to be spent on improvements to $1,270,000.

RAILWAYS

Alberni, B.C.—The C.P.R. has let the contract to the Foundation Co. for the building of the extension of its railway line from Alberni to Great Central Lake, a distance of 10½ miles. It is expected it will be completed by next July.

Bulyea, Sask.—C.P.R. may construct a branch line to connect up Foam Lake with Bulyea.

Hamilton, Ont.—Ratepayers of Hamilton, on January 1st, are going to be asked to guarantee an additional $607,000 for the proposed Hydro-radial in this district. According to a statement made by Sir Adam Beck at the recent Hydro-radial meeting at Galt, Hamilton is one of seventeen municipalities which will be called upon to pass further by-laws. The extra $607,000 which Hamilton is to be asked to guarantee is for the work of tunneling under Hamilton cemetery and Harvey park, and connecting up the line from Kitchener, Guelph, Galt and Dundas with the main line to the border.

Ottawa, Ont.—The Department of Railways will in the near future link up the National Transcontinental Railway with the Canadian Northern, by the construction of a spur from Grant to Long Lake, about 200 miles east of Fort William.

Prince Albert, Sask.—Provided the Dominion government grants the needed appropriation, the C.N.R. will begin grading two branch lines in the Prince Albert district next spring. The first branch will extend for a distance of 45 miles in a northeasterly direction to Birch Bark Lake, and the other will extend a distance of 25 miles in a westerly direction from Shellbrook.

Quebec, Que.—Application will be made at the next session of the legislature for the incorporation of the Quebec and Chibougamau Railway, which intends to build a railway in this province. The names given among the applicants are Joseph C. Cote, agent, Quebec; William James Ewing, registrar, Richmond, Que.

St. John's, Nfld.—St. Georges Coal Fields, Ltd., plan extensive development work, and construction of new branch lines of railway. Manager, T. J. Freeman.

Toronto, Ont.—City council decided to submit to the ratepayers at the next civic election the agreement covering Toronto's participation in the construction of the proposed hydro-radial between this city and Bowmanville. The bond issue involved is for $4,328,665.

Whitby, Ont.—Whitby town and West Whitby township passed the by-law to guarantee the bonds of the proposed Toronto and Eastern radial.

FACTORIES AND LARGE BUILDINGS

Belleville, Ont.—Contract let to Thomas Manley & Son, of this city, for erection of new main building for Ontario School for the Deaf. Work of excavation has started.

Belleville, Ont.—The Ontario Oakoal Co., Ltd., will erect and equip a plant to convert the city's garbage and waste material into fuel. Estimated cost, $40,000.

Big Valley, Alta.—Municipal Hospital Board plans erection of hospital. By-law will be submitted.

Brandon, Man.—Contract let to F. Lissaman for alterations to the post office to cost $6,000.

Brandon, Ont.—Tentative plans for a new fireproof building at the Brandon General Hospital have been prepared by Stevens and Lee, architects, Toronto.

Brantford, Ont.—A Roman Catholic hospital will be erected here.

Bridgeburg, Ont.—An issue of $50,000 debentures is being made for additions to the public school. Town clerk, R. A. Land.

Calgary, Alta.—City commissioners are considering the erection of a municipal abattoir.

Calgary, Alta.—Premier Charles Stewart, Edmonton, has notified Mayor R. C. Marshall that the construction of the new Normal School may be started this winter.

Calgary, Alta.—Contract let to A. B. Himmelman for alterations to building on Eighth Ave. for the Standard Agencies. Estimated cost, $5,000.

Chatham, Ont.—C. H. Crane, architect, Detroit, Mich., will prepare plans for the erection on King St., of a large theatre.

Chatham, Ont.—Negotiations have been reopened by the government with the directors of the Hotel Sanita, for the purchase of the building to be converted into a sanatorium for returned soldiers.

Chatham, Ont.—Additions are being constructed to the plant of the Canadian Fertilizer Co., and the mill of the T. H. Taylor Co.

Clyde, Alta.—Clyde Consolidated School District plans erection of school.

Dartmouth, N.S.—Imperial Oil Co. plans to enlarge its refinery here very shortly. An expenditure of approximately $1,000,000 will be involved in connection with the work. Chief engineer, Thos. Montgomery, 56 Church St., Toronto.

Edmonton, Alta.—Edmonton, Dunvegan & B.C. Railway plans additions to depot.

Edmonton, Alta.—Edmonton Public School Board and the University of Alberta plan erection of large school. President of University, Dr. Torn.

Edmundston, N.B.—A school costing $100,000 will be erected here next spring. Mayor, Mr. Michaud.

Elmira, Ont.—A movement is on foot by the Ladies' Patriotic League for the erection of a soldiers' memorial hospital.

Fort William, Ont.—Provincial government may build additions to the Industrial Experiment Station here. Architect of the Department of Agriculture, C. J. Govson, Parliament Buildings, Toronto.

Fort William, Ont.—Fire recently destroyed the city's car barns. The burned building was insured for $85,000, and the rolling stock for $195,000. Plans are under way for rebuilding the barns. Clerk, Alex. McNaughton.

Fraserville, Que.—New tenders will be called for addition to St. Joseph's Hospital. Cost, $100,000. Architect, Pierre Levesque, 115 St. John St., Quebec.

Guelph, Ont.—The Dominion Bank has purchased a site at the corner of Wyndham and Macdonnell Sts., and will erect a new building.

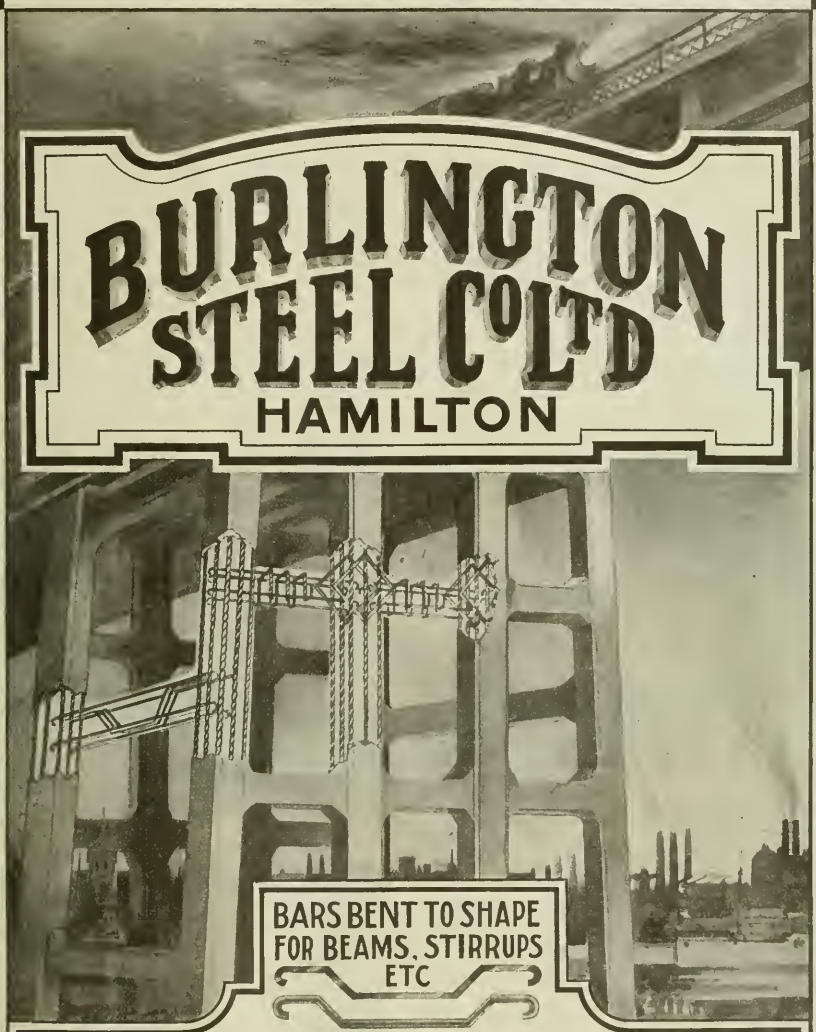
Guelph, Ont.—This year the local Housing Commission is erecting 24 houses at a total expenditure of $66,000, and next year it is hoped to build several hundred houses.

Hamilton, Ont.—A new branch post office is being erected on Barton St. Estimated cost, $40,000.

Hamilton, Ont.—The International Plow Works Co. will erect a $100,000 extension to its present large plant.

Hamilton, Ont.—The United Aircraft Engineering Corporation of New York has offered to erect and operate a municipal airdrome if the city will provide a site.

BURLINGTON STEEL CO LTD
HAMILTON



BARS BENT TO SHAPE FOR BEAMS, STIRRUPS ETC

STEEL BARS
FOR CONCRETE REINFORCEMENT
ROUNDS, SQUARES, TWISTED SQUARES, FLATS, ANGLES.

Kitchener, Ont.—The erection of an addition to the House of Refuge is being considered by the board of management.

Kitchener, Ont.—The Dominion Rubber System will start work immediately on the erection of a number of houses in Kitchener and Waterloo.

London, Ont.—A deputation will go to Ottawa to ask the government to build a new railway station.

London, Ont.—The London and Western Trust Co., Ltd., will shortly erect a new building on Richmond St.

London, Ont.—Tentative plans are being considered by the directors for the expansion of the arts departments of the Western University, including the erection of a new dormitory building.

London, Ont.—The board of governors of Western University appointed E. V. Buchanan, of the Utilities Commission, to superintend the erection of the new medical school building. Mr. Buchanan's services will be given gratis. The contract for the general construction work to cost $234,000, was awarded to John Puterbough. Bennett & Wright, of Toronto, were awarded the plumbing work at a cost of $70,000. The electrical work and painting have not yet been let. It is expected that the entire cost of the building, including furnishings, etc., will be $350,000.

Montreal, Que.—Building permit granted to the Alaska Bedding Co.., for the erection of a $200,000 building.

Moosomin, Sask.—The question of enlarging the Union Hospital is under consideration. Commissioner of Public Works for Saskatchewan, Dr. M. M. Seymour, Regina.

Nanaimo, B.C.—A movement is on foot here for the establishment of an isolation hospital. Medical health officer, Dr. Drysdale.

Newdale, Man.—The municipal council will be asked to submit a by-law to the ratepayers authorizing the erection of a municipal memorial hall.

New Toronto, Ont.—Lake Shore Road G.W.V.A. contemplate erection of memorial hall. Secretary, J. Neil, Box 206, New Toronto.

Ottawa, Ont.—The Swift Canadian Co. will erect a large warehouse on Besserer St.

Ottawa, Ont.—Public School Board plans additions to two schools. Chairman, R. W. Hamilton.

Owen Sound, Ont.—There is a strong probability that a large addition will be made to the Patterson Hotel in the spring. Proprietor, Mr. Douglas.

Quebec, Que.—Price Bros. & Co. will erect a large office building on St. Lawrence St.

Quebec, Que.—Sir William Price, president of Price Brothers and Co., has announced that the company will start work, without delay, on a large newsprint mill in the Saguenay district.

Raymond, Alta.—The Standard Bank of Canada has taken a lease on the front half of the King and Green Building for the purpose of converting it into a new branch office.

Rossland, B.C.—The Consolidated Mining and Smelter Co. contemplates the installation of a new concentrator, which will involve the outlay of at least a million dollars.

Sandwich, Ont.—The Fisher-Wilkie Foundry Co. proposes to build a $200,000 factory here.

Sarnia, Ont.—Tenders will be received by R. W. Fawcett, architect, up to noon, Tuesday, November 18th, 1919, for the erection of a public school building. Plans and specifications may be seen at the architect's office, 116½ Front St., Sarnia.

Saskatoon, Sask.—The local government board has given consent to the by-law authorizing the expenditure of $300,000 for an extension to the collegiate institute. The board also advised that additional equipment be allowed for at the same time, and included an extra $50,000 for this purpose.

Seaforth, Ont.—Ratepayers defeated the by-law for a soldiers' memorial and clubhouse.

Sherbrooke, Que.—The Cluett-Peabody Co. will locate a branch in this city.

Sherbrooke, Que.—The Walter Blue Co. propose to enlarge their factory.

St. John, N.B.—The Dominion government may proceed shortly with the construction of the new baggage and passenger shed and other facilities at West St. John docks, which will cost approximately $276,000. In addition, the extension of the grain conveyors to berth No. 15 has been recommended.

St. Jules, Que.—Quebec Central Railway plan erection of station. Manager, M. Walsh, Sherbrooke, Que.

St. Mary's, Ont.—Ratepayers defeated the by-law to provide $5,000 for a clubhouse for the returned men.

St. Thomas, Ont.—The Board of Trade will promote a campaign to raise funds for the erection of a memorial hospital. Secretary, Mr. Lodge.

Toronto, Ont.—The Fred Victor Mission, Queen and Jarvis Sts., will erect a new building at 341 Jarvis St.

Toronto, Ont.—Fire completely destroyed the sheds and garage of the Lambton Golf and Country Club. Loss, $16,500.

Toronto, Ont.—Holy Name parish, Danforth Ave. district, will erect a public hall on Carlaw Ave. Approximate cost, $25 000.

Toronto, Ont.—Board of Control decided to ask the Harbor Board to provide a site for a fire station in the Ashbridge's Bay industrial district.

Toronto, Ont.—The works committee approved the plans of the General Fire Extinguisher Co. for a factory on Dundas St. Approximate cost, $500,000.

Toronto, Ont.—Permit issued to the A. D. Gorrie Co. for the erection of a reinforced concrete garage at 354-60 Victoria St., at a cost of $80,000.

Toronto, Ont.—Permit granted for the erection by the Merchants Bank of Canada of a four-story granite, limestone and brick building at 12 King St. West. Estimated cost, $180,000.

Toronto, Ont.—Contract let to the Frid Construction Co., Ltd., 61 Adelaide St. E., for the erection of new building on east side of Yonge St., south of Shuter St., for the Adams Furniture Co. Approximate cost, $325,000.

Toronto, Ont.—Ten acres of the western section of the Hillcrest race track property have been purchased by the Prest-O-Lite Co., Ltd., corner Elm St. and Centre Ave., Toronto, for the erection of a large manufacturing plant.

Toronto, Ont.—The following building permits have been issued: Grand Trunk Railway, additional story to present building, Station Street, southeast corner York Street, $52,000. William Davies Co., alterations to building, 804 Yonge Street, $10 000.

Toronto, Ont.—Contract let to the John V. Gray Construction Co., Confederation Life Building, for reinforced concrete work on manufacturing building for Dunlop Tire and Rubber Goods Co., 244 Booth Ave. Estimated total cost of building, $250 000. Architect and engineer, B. H. Prack, Lumsden Building.

Toronto, Ont.—A $1,000,000 extension is being built by Baldwin's, Ltd., to the plant of the British Forgings Co., which they have acquired. The present buildings are also being refitted and equipped. A 125-ton power wheel is now being installed. Power will be secured from the Hydro-Electric Power Commission of Ontario.

Toronto, Ont.—Board of Control awarded the following contracts in connection with the erection of a new public lavatory building at Island Park: Masonry, Teagle & Son, price $6,176; plumbing and drainage, Crawford & Hodgson, $2,160; painting and glazing, R. G. Johnston; carpentering, F. J. Murphy, $4,440; electric wiring, Harris & Marson; plastering, John Boyce & Son.

Toronto, Ont.—John Catto & Son will spend $30,000 on improving the property at the corner of Yonge and Shuter Sts., to which building they will shortly remove. The store at present occupied by them on King St. has been purchased by the King Edward Hotel Co. for large extensions to that hostelry.

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Paper Insulated Telephone Cable
Portable Lamp Cord
Rubber Covered Wire
Rubber Covered Cable
Show Window Cord
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Weatherproof Copper Wire
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Toronto, Ont.—Tenders, addressed to W. C. Wilkinson, secretary-treasurer, Board of Education, Administration Building, 155 College Street, will be received until Thursday, November 27th, 1919, for plastering, John Fisher School. Electric wiring, Bolton Avenue and Duke Street schools. Telephones, Jesse Ketchum and Queen Alexandra schools. Fresh air inlets, Perth Avenue and Harbord Street Collegiate Institute. Pipe covering, various schools. Plumbing, Bolton Avenue school. Specifications may be seen at the office of the Superintendent of Buildings, 155 College Street.

Trenton, Ont.—W. J. Carmichael, architect and engineer, 29 Hospital St., Montreal, will prepare plans for exchange office for Bell Telephone Co.

Vancouver, B.C.—The Canadian Northwest Steel Co. has taken out a permit for a crane shed to cost $6,500.

Vancouver, B.C.—The establishment of a curling rink is being considered. Publicity Commissioner, J. R. Davison.

Victoria, B.C.—The Dominion government plans are now ready and the necessary appropriation for construction has been made for the erection of the new offices of the Marine Department on the Songhees Reserve. The new building will cost between $50,000 and $100,000.

Victoria, B.C.—City council decided to adopt the federal Housing scheme, and to accept Victoria's $180,000 housing allocation.

Walkerville, Ont.—The school board requested the town council to grant $25,000 for the purpose of establishing a technical school.

Waterdown, Ont.—Council decided to submit a by-law in January next to raise $20,000 for the erection of a memorial hall. Clerk, J. C. Medlar.

Welland, Ont.—In his report to the city council, W. M. German, industrial commissioner, states that the following industrial companies are likely to locate plants in this city: McCaskey Systems, Ltd., Toronto; Smith & Sons, of Buffalo, manufacturers of wire specialties; a firm manufacturing high speed tools at Albany, N.Y., and an automobile concern.

Wentworth County, Ont.—County Council will consider erection of a new school in Saltfleet township. Reeve, T. J. Mahoney.

Weston, Ont.—Contract let to B. G. McCallum for erection of factory for McCallum, McLaren, Ltd. Cost, $3,000.

Windsor, Ont.—The Bank of Hamilton propose to erect a branch bank at the corner of Ouellette Ave. and Chatham St.

Windsor, Ont.—A site of 63 ft. on Wyandotte and Lincoln Avenues has been secured by the Imperial Bank of Canada, and next season a new branch building will be erected.

Winnipeg, Man.—Contract let to Gray & Davidson for erection of garage costing $25,000 for Grey-Ogletree Motor Co., 621 Wall St.

Winnipeg, Man.—Plans have been prepared by the provincial government for the erection of a deaf and dumb institute. Estimated cost, $600,000. Deputy Minister of Public Works, S. C. Oxton.

York Township, Ont.—Separate and bulk tenders for one or both of two eleven-roomed schools to be built in Fairbank near Eglinton Avenue and Vaughan Road, S. S. No. 15, will be received until November 25th, 1919. Contracts call for brick work, hollow tile, terrazzo floors, steel casement sash, carpentry work, electric work, plastering, painting, plumbing and heating, etc. Plans and specifications may be obtained at the office of S. B. Coon & Son, architects, 810 Excelsior Life Building, Toronto.

MISCELLANEOUS

Guelph, Ont.—The E. A. Lowry Power Equipment Co., Herald Building, has recently been incorporated under provincial charter with an authorized capital of $50,000. The company specializes in contracting for electrical power equipment for operating all manufacturing industries using electric motors, generators, transformers, etc., in the larger sizes. Contracts are held with the Canadian Westinghouse Co., Ltd., for supplying motors, etc., and with whom a large order for motors has just been placed. E. A. Lowry is president of the company.

Hamilton, Ont.—A by-law to raise $150,000 for the development of Scott Park as an athletic field and for improvements to Victoria and North End parks will be submitted to the ratepayers in January.

Hamilton, Ont.—Fire Chief A. B. TenEyck has recommended the installation of a new fire alarm system at an estimated cost of $10,000. A by-law may be submitted to the ratepayers in January.

Lakefield, Ont.—Tenders, addressed to J. W. Pugsley, secretary, Department of Railways and Canals, Ottawa, and endorsed, "Tender for Rebuilding Dam at Lakefield, Trent Canal," will be received until 12 o'clock noon on Saturday, November 29th, 1919. Plans and specifications may be seen at the office of the Chief Engineer of the Department of Railways and Canals, Ottawa, and at the office of the Superintending Engineer, Trent Canal, Peterborough, Ont.

Levis, Que.—The newly formed National Shipbuilding Co. has taken over the old-time Veilleux shipyards here and will build at least fifteen large vessels for which contracts have been secured.

Naramata, B.C.—Contract let to S. Mills, New Westminster, by Dominion government, for construction of wharf.

North Vancouver, B.C.—Contracts for two steel steamers of 8,350 deadweight tons each have been awarded to the Wallace shipyards, North Vancouver, by the Dominion government. Work will commence immediately.

Ottawa, Ont.—Incorporation has been granted to the following joint stock companies: Electric Machinery Co., Ltd., Montreal, capital $100,000; Rex Oil Burner, Ltd., Montreal, $50,000; Frontenac Construction Co., Ltd., Quebec, $75,000; Canadian Coal Briquette & Liquid Fuel Co., Ltd., Montreal, $70,000; St. Lawrence Dock & Shipbuilding Co., Ltd., Levis, $100,000; the American Fuel Co., Ltd., Toronto, $100,000.

Portage la Prairie, Man.—On December 16th next, by-laws calling for the issuance of debentures will be submitted to the ratepayers as follows: City hall and community building, $100,000; waterworks, $12,000; electric light, $16,000. Clerk, W. R. Grieve.

Queensville, Ont.—The council of East Gwillimbury have instructed the E. A. James Co., Ltd., Toronto, to prepare plans for the drainage of a section of the Holland Marsh. The first area reclaimed will comprise some 6,000 acres, and the work contemplated includes a 12-foot dike, bridges and a pumping plant to keep the water in this area some two feet lower than Lake Simcoe.

St. John, N.B.—Debentures will be issued to the amount of $389,000 for various local improvements as follows: Waterworks, $318,500; wharf repairs, $33,500; roads, $37,500. City engineer, G. N. Hatfield.

The Pas, Man.—Dominion government let contract to M. J. Wylie and L. Perry, Winnipeg, for construction of wharf.

Vancouver, B.C.—Dominion government will prepare plans and specifications, and call for tenders for the construction of a large pier on Burrard Inlet. Plans are also being prepared for two steamers for service from Vancouver, Victoria and Seattle, and tenders will be called for these ships from Canadian shipyards.

Vancouver, B.C.—Tenders will be received by F. H. Shepherd, Superintendent of Dredges, Department of Public Works, Canada, Vancouver, B.C., until 4 p.m., on Monday, November 24th, 1919, for repairs and general overhaul of the Departmental Dredge No. 303 ("Fruhling"). Specifications may be seen at the offices of A. F. Mitchell, Acting District Engineer, Victoria, B.C.; C. C. Worsfold, District Engineer, New Westminster, B.C., and of F. H. Shepherd, 710-713 Birks Building, Vancouver, B.C.

Victoria, B.C.—H. M. Davey, engineer, Public Works Department, Ottawa, was in this city recently and looked over the plans for the proposed new drydock for Victoria. Mr. Davey took the borings of the proposed site, and stated

"A valuable publication for the municipal engineer."—*American City*

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that he expected construction work would begin at an early date.

Walkerville, Ont.—Bell Telephone Co. will erect a new exchange building here early next year. In addition to this development the company proposes to erect cables on every street, replacing the wires which now serve in many cases. The estimates call for an expenditure of between $150,000 and $200,000 on this cable scheme. The plans also call for much underground work. A new switch board will also be installed in Windsor.

Woodstock, Ont.—Tenders, addressed to R. C. Desrochers, secretary, Department of Public Works, Ottawa, will be received until 12 o'clock noon, Friday, November 21st, 1919, for Woodstock, Ont., post office fittings. Plans and specifications may be seen at the offices of the Chief Architect, Department of Public Works, Ottawa; the Caretaker, Public Building, Woodstock, Ont., and the Superintendent of Dominion Buildings, Postal Station "F," Yonge Street, Toronto, Ont.

Tenders Called For

HYDRO-ELECTRIC POWER COMMISSION OF ONTARIO

RAILWAY DEPARTMENT

SUPERSTRUCTURE OF HIGHWAY BRIDGE ACROSS WELLAND RIVER AT CHIPPAWA, ONTARIO

ADVERTISEMENT FOR TENDERS

Sealed tenders will be received until November 28th, 1919, at 12 o'clock noon, addressed to Sir Adam Beck, Chairman, Hydro-Electric Power Commission of Ontario, 190 University Avenue, Toronto, Ontario, and marked "Tender for Chippawa Highway Bridge." Plans, specifications, and other information may be obtained by applying to the office of Chief Engineer. The Commission reserves the right to reject any or all tenders received.

Hydro-Electric Power Commission of Ontario.

W. W. POPE,
Secretary.

Dated at Toronto, November 14th, 1919. 375

ESSEX BORDER UTILITIES COMMISSION

Proposals will be received by the Essex Border Utilities Commission until November 27th for completing the South Sewage Interceptor in Sandwich and Ojibway, Ont.

The work consists of laying approximately the following lengths of reinforced concrete lock-joint pipe in four-foot lengths, which is now on the work.

42" diameter—16'
39" " —4360'
27" " —4320'

Building fifteen (15) concrete and brick manholes and setting cast-iron frames and covers; pumping and clearing out four thousand (4,000)feet of existing sewer 42" and 27" in diameter, and shaping up ditches; replacing 80 sq. yds. of concrete street pavement.

The depth of the excavation is approximately 13—15 feet consisting of sand and clay.

The work lies along a concrete-paved roadway, and is readily accessible. The contractor will be required to furnish suitable pumping equipment.

Plans and specifications may be obtained at the office of Morris Knowles, Ltd., 66 Ouellette Ave.

Essex Border Utilities Commission.

GORDON McGREGOR, Chairman. W. J. BAXTER, Secretary. 374

Condensed Advs.

Advertisements under this heading at following rates per insertion, with fifty cents per insertion as minimum rate in any case; "Positions Wanted," one cent per word; all other condensed advertisements, three cents per word. Payable in advance; 50 per cent. extra if charged.

GENERAL SUPERINTENDENT wanted for hydraulic construction. Must be able to take complete charge. Reply stating age and experience. Box 23, *The Canadian Engineer*, Toronto.

DRAFTSMAN WANTED.—Good general draftsman used to designing and drafting. State experience and salary expected. William Hamilton Company, Limited, Peterborough, Ont. 379

WANTED.—Engineer-draftsman, 18 years' experience, Structural Steel, Plant Design and Maintenance, desires position of responsibility, executive or otherwise. Box 21, *Canadian Engineer*, Toronto.

ENGINEER.—Research Mechanical Engineer, with very best education and experience as such wanted by Pulp and Paper Manufacturing Plant. State education, experience, age, married or single, and salary asked for. Also send copies of references. Only very best men need apply. Box 25, *The Canadian Engineer*, Toronto.

MANUFACTURER in Eastern Townships, having good facilities and considerable experience in the production of a wide variety of machinery lines, desires to undertake the manufacture (for the Canadian or export trade) of American or English machinery. Full particulars gladly upon request. Box 396, *Canadian Engineer*, Toronto.

PATENT NOTICE.—Any one desiring to obtain the invention covered by Canadian patent No. 179286, granted September 11th, 1917, to Whitmore Brothers, Corporation of Cambridge, Massachusetts, U.S.A., for box, may do so upon application to the undersigned, who are prepared to supply all demands on the part of the public for the invention and from whom full information may be obtained. Fetherstonhaugh & Co., 5 Elgin Street, Ottawa, Canada; Russel S. Smart, resident. 377

PATENT NOTICE.—Any one desiring to obtain the invention covered by Canadian patent No. 180382, granted on November 13th, 1917, to the L. Moore Dry Kiln Company, assignee of Chas. J. Williams, Jr., both of Jacksonville, Florida, U.S.A., for hanger, may do so upon application to the undersigned, who are prepared to supply all reasonable demands on the part of the public for the invention, and from whom full information can be obtained. Fetherstonhaugh & Co., 5 Elgin Street, Ottawa, Canada; Russel S. Smart, resident. 378

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The Canadian Engineer

A Weekly Paper for Civil Engineers and Contractors

Analysis of Concrete-Proportioning Theories

Data Upon Which Abrams' Fineness Modulus and Edwards' Surface Area Methods Are Based Show Validity of Water-Cement Ratio Theory and Demonstrate That Fineness Modulus Varies With Surface Area—Tests All Agree But Interpretations Differ

By RODERICK B. YOUNG

Engineering Materials Laboratory, Hydro-Electric Power Commission of Ontario

IN the last eighteen months, much new information has been published on the laws underlying concrete mixtures, and at least two different methods of proportioning based on this new data have been proposed. These two methods, the "fineness modulus method" of Prof. Duff A. Abrams, and the "surface area method" of Lewellyn N. Edwards, have been described in detail in *The Canadian Engineer*. The two methods would seem to be conflicting. The discussion both for and against, which the publication of these methods has occasioned, and the direct contradiction of their basic principles made by the engineers of the Bureau of Standards, has further tended to strengthen this impression and to obscure the fact that the published data of the different parties to this controversy, if not the conclusions derived therefrom, are in striking agreement.

Prof. Abrams' method is based primarily upon a relationship which he has discovered between the compressive

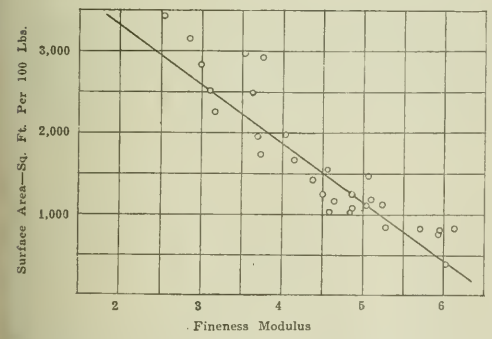

FIG. 1—RELATION BETWEEN FINENESS MODULUS AND SURFACE AREA OF GRADED AGGREGATES (FROM H. E. P. C. TESTS)

strength of a concrete and the ratio between the volume of water and volume of cement used in producing it. He claims that for given concrete materials, the strength depends on only one factor, the ratio of water to cement, called for convenience the water-cement ratio, that this relation holds so long as the concrete is workable, and that the character of the aggregate makes little difference so long as it is clean and not structurally deficient, and so long as proper account is taken of differences in their absorptive qualities. From this he concludes that the size and grading of the aggregate, and the quantity of cement, are of no importance except in so far as these factors influence the quantity of mixing water required to produce a workable concrete.

The fineness modulus of an aggregate is obtained from its sieve analysis. The percentages of material coarser than each of the sieves used, is summed and the result divided by 100. Prof. Abrams has standardized on a particular set of sieves, the basic sieve of which is the No. 100, having a sieve

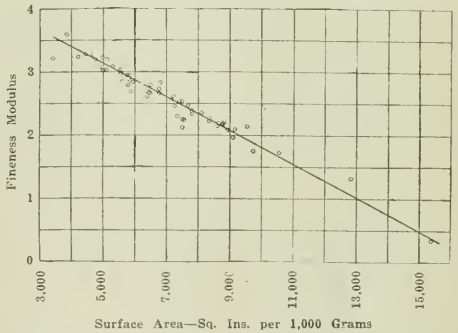

FIG. 2—MR. EDWARDS' DIAGRAM SHOWING RELATION BETWEEN SURFACE AREA AND FINENESS MODULUS

opening of 0.0058 in. In each succeeding sieve of the series, the opening is double the width of the preceding one.

Prof. Abrams claims that this fineness modulus enables one to interpret properly the sieve analyses of an aggregate, and that all aggregates of the same fineness modulus require the same quantity of water to produce a mix of the same

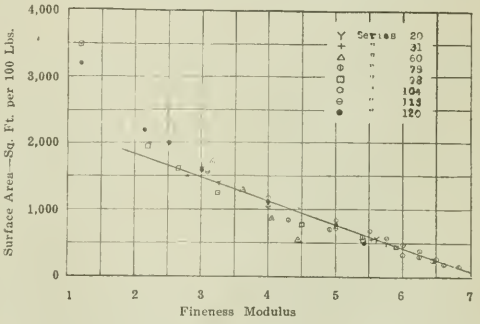

FIG. 3—RELATION BETWEEN FINENESS MODULUS AND SURFACE AREA—DERIVED FROM RESULTS OF PROF. ABRAMS' TESTS

plasticity and to give concrete of the same strength, so long as the aggregate is not too coarse for the quantity of cement used. This, he says, is because the fineness modulus simply reflects the changes in water-cement ratio necessary to produce a given plastic condition.

Mr. Edwards' method is based on the theory that for uniform plasticity and uniform strength, the cement varies

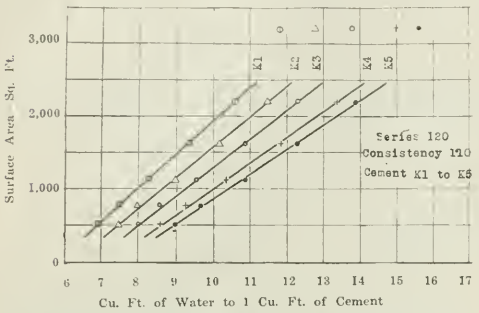

FIG. 4—RELATION BETWEEN MIXING WATER AND SURFACE AREA TO GIVE CONSTANT PLASTICITY (DERIVED FROM PROF. ABRAMS' TESTS)

as the surface area of the aggregate; and further that the quantity of water required to produce mortars of uniform consistency is a function of the water required to reduce the cement to a "normal" paste and of the surface area of the sand particles to be wetted.

In other words, Mr. Edwards claims a relation between strength and surface area, and between mobility and surface area and his tests support his theories so far as mortar mixtures are concerned. Later tests by the Hydro-Electric

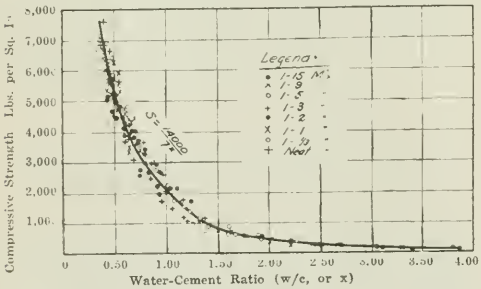

FIG. 5—PROF. ABRAMS' DIAGRAM SHOWING RELATION BETWEEN WATER-CEMENT RATIO AND STRENGTH OF CONCRETE

Power Commission of Ontario, under the direction of the writer, show that these conclusions are equally applicable to concrete mixtures.

Mr. Edwards obtains the surface area of an aggregate by counting and weighing some of each size of aggregate obtained in a sieve analysis, and from this data determining the average number of particles per unit weight for each size. Then, assuming these to be spherical, and knowing their specific gravity, he calculates the average volume per particle, the surface area per particle, and hence the total surface area per unit weight for each size of separation.

The surface area of any mixed material can be found by multiplying the surface area per unit weight of each size of separation by the weight of that size present in the material, and adding these. The value thus obtained is not the true surface area, for the latter cannot be obtained, as the particles are not true spheres, are variable in shape and have not smooth surfaces. However, this value undoubtedly bears a constant relation to the true surface area, and for all practical purposes is equally as useful.

The Bureau of Standards, Washington, D.C., made a limited series of tests to check the findings of these investigators. As a result the Bureau claims that the water-cement ratio is only an incidental relation of no direct value to the engineer in proportioning concrete, that a wide difference in strength is found with constant water-cement ratio and that there is no relation between surface area and strength. These conclusions directly contradict the findings of the two last-mentioned investigators.

At a later time, however, the Bureau makes this interesting statement: "Our tests indicate that for constant flow-

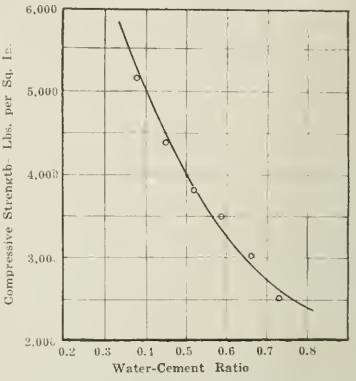

FIG. 6—RELATION BETWEEN WATER-CEMENT RATIO AND STRENGTH OF CONCRETE (PLATTED FROM MR. EDWARDS' TESTS)

ability the water required varies with the surface area of the aggregate."

Other investigators are working upon these different theories, although their results have not yet found their way into print. Prof. A. N. Talbot, of the University of Illinois, has said of his investigations, carried out upon concretes of one consistency and cement content:—

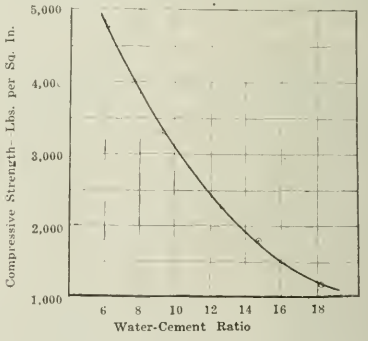

FIG. 7—RELATION BETWEEN WATER-CEMENT RATIO AND STRENGTH OF CONCRETE (PLATTED FROM BUREAU OF STANDARDS' TESTS)

"The tests indicate that for an aggregate having a given size of particles, the amount of mixing water required to produce a concrete of a given consistency, or mobility, is equal to a constant plus a term which is dependent upon the surface area. The tests show that the strengths of these con-

cretes, made up to have the same mobility, are also dependent upon the surface area. Concretes having the same water-cement ratio give nearly the same strength through a part of the range of water-cement ratio values, but for each maximum size of particle, the results diverge from the main curve,—this occurring at places along the curve which vary with the maximum size of particle and which are quite far apart."

The Hydro-Electric Power Commission of Ontario has been conducting investigations along similar lines. Some of the conclusions so far reached are:—

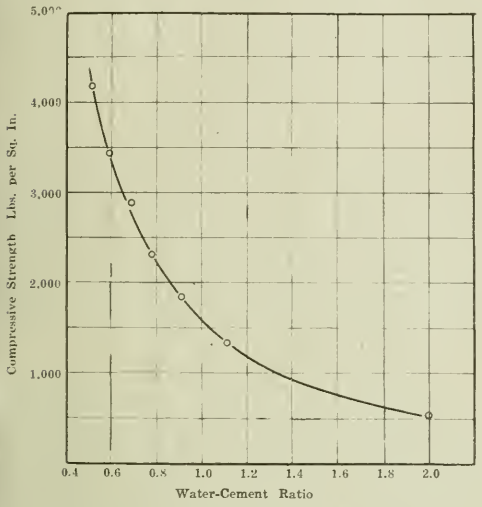

FIG. 8—RELATION BETWEEN WATER-CEMENT RATIO AND STRENGTH OF CONCRETE (H. E. P. C. TESTS)

1. That the fineness modulus is but another and somewhat approximate method of defining the surface area.

2. That within the range of workable mixtures, both the "strength" and "water required to bring a mixture to a uniform degree of plasticity" vary with the surface area, the relation being actually that described by Messrs. Talbot and Edwards.

3. That there is a fixed relation between water-cement ratio and strength for mixtures of the same cement, same aggregate and same age.

Fineness Modulus and Surface Area

Fig. 1 shows the relation found when the fineness moduli of mixed aggregates are platted against their surface areas as determined by the Edwards method.

This figure is similar to one given by the writer in *The Canadian Engineer*, June 26th, 1919, issue, except that it covers materials from dust to 1½ ins., while the former included only sands graded from dust to ¼ in. In the article just referred to, algebraical expressions for both the fineness modulus and surface area were derived, and it was shown that no mathematical relation exists between them. While an infinite number of values of fineness modulus may be found for any one value of surface area, and vice versa, yet it is a remarkable fact that for the materials ordinarily encountered, fineness modulus varies approximately with the surface area.

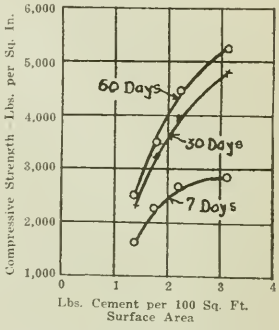

FIG. 12—RELATION BETWEEN CEMENT CONTENT AND COMPRESSIVE STRENGTH (PLATTED FROM MR. EDWARDS' TESTS)

Figs. 2 and 3 show similar curves obtained from the data of Mr. Edwards and Prof. Abrams, respectively.

Fig. 2 was reported by Mr. Edwards in *The Canadian Engineer* for October 9th, 1919, while Fig. 3 was worked up from Prof. Abrams' published results, and includes materials graded from 0-No. 28 sieve to 0-1½-in. sieve, a wider range than is included in either Figs. 1 or 2.

The relationship is probably the explanation of the reason that Prof. Abrams has found fineness modulus to be a measure of the effective size and grading of the aggregate.

Consistency and Surface Area

Prof. Talbot's conclusion that the water in concretes of equal cement content, necessary to produce a concrete of a given consistency, is equal to a constant plus a term which

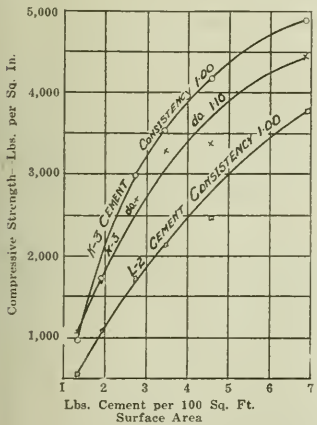

FIG. 9—*Derived from Prof. Abrams' Tests*

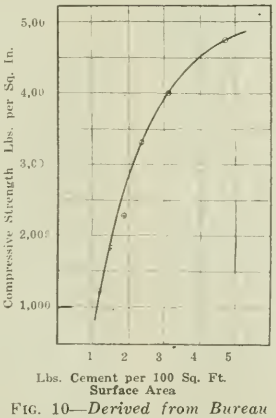

FIG. 10—*Derived from Bureau of Standards' Tests*

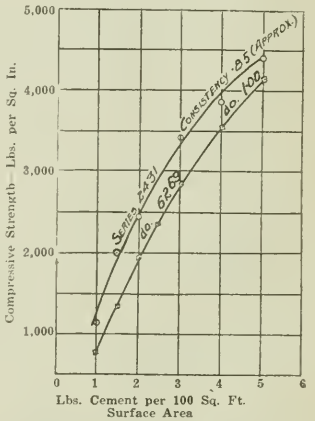

FIG. 11.—*H. E. P. C. Tests*

RELATION BETWEEN CEMENT CONTENT AND COMPRESSIVE STRENGTH OF CONCRETE

is dependent on the surface area, is the same conclusion arrived at by Mr. Edwards in his study of mortars. The writer's studies of both theoretical and experimental data corroborate this conclusion. The engineers of the Bureau of Standards confirm this partially when they state that their tests indicate that for constant flowability the water required varies with the surface area of the aggregate. Prof. Abrams uses his fineness modulus to proportion mixtures to a given consistency, and to do this uses a formula in which the water required is the sum of a quantity dependent on the amount of cement used and a quantity varying with the fineness modulus. Assuming fineness modulus to be another way of stating surface area, or vice versa, it is evident that the work of each of these investigators point to the same end.

Unnecessary to Make Assumption

It is, however, unnecessary to make the foregoing assumption to show that Prof. Abrams' results bear proof of this relation between mixing water and surface area at a given consistency. Fig. 4, which was worked up from the data in his paper* on "Effect of Fineness of Cement," shows five series of mixtures in which cements of different fineness were used, each proportioned 1:4 by volume with six different aggregates of a wide range in grading. The mixtures were all gauged to a uniform consistency, the water to do this being determined by means of Prof. Abrams' water formula. It is a striking confirmation of the law outlined in the last paragraph, that in the case of each of the different cements, when the amount of mixing water used is platted against the surface area of the aggregate in the mixtures, five of the six points lie on a straight line. The sixth point represents a mixture in which the material was a very fine sand, 10% of which was dust or silt. Under these conditions it is hardly to be expected that this point would agree with the other and more usual materials, because our means of determining equal mobilities are not such as to function accurately under these conditions.

The results of Fig. 4 cannot be explained by the fact that the surface area and fineness modulus have approximately a linear relation, for in the series represented (see Fig. 3, Series 120), this relation is a slight curve.

Water-Cement Ratio and Strength

Fig. 5, taken from the article by Prof. Abrams which was published in *The Canadian Engineer* for June 6th, 1918, shows the general relation found by Prof. Abrams between compressive strength and water-cement ratio. This curve covers an extremely wide range of mixtures, materials and consistencies. Fig. 6 is platted from the results of Mr. Edwards' mortar tests and show a similar relationship for the range covered by his tests. In these tests the proportions were constant, but the consistency varied. Fig. 7 is platted from data published by the Bureau of Standards from tests in which the consistency was nearly uniform, but in which the proportions varied. Fig. 8 is a similar series, carried out by the writer in the laboratories of the Hydro-Electric Power Commission of Ontario. Similar curves have been obtained in the same laboratory where the proportions were constant and the consistency varied. In all of these curves the mixtures used were plastic. The relationships are practically identical in each of these figures, showing very good agreement on this point.

Prof. Abrams has shown that for given materials and age, approximately equal strength will be obtained even with widely different grading of aggregate and consistency, provided that the mixtures are plastic and that the grading is not too coarse for the quantity of cement used.

Mr. Edwards in his early tests on surface area proved the same things, for he varied both the cement and water according to the surface area and obtained a constant water-cement ratio, and his mortar mixtures were of nearly equal strengths.

It is hard to reconcile the Bureau of Standards' claim that "a wide difference in strength is found with constant water-cement ratio even with the same aggregate and cement," unless it is that these tests were designed to give unusual conditions.

Prof. Abrams, in commenting on the Bureau's tests, has said of the aggregate used: " Over 40% of the aggregates were too coarse for the quantity of cement used; 26% of the mixes were too dry; 21% were both too coarse and too dry; 72% of the aggregates were of freakish grading." The writer agrees with Prof. Abrams' criticism, and considers this to be the explanation of the unusual results obtained.

It is interesting to note that Fig. 7, drawn from data obtained by the Bureau of Standards before the controversy arose, while not bearing upon the disputed question of equal water-cement ratios having equal strengths, shows that a consistent relationship is being obtained in this laboratory for commercial aggregates and plastic consistencies.

Surface Area and Strength

If, for workable mixtures of similar materials, a given strength concides with a fixed water-cement ratio, then it is evident that if the quantity of water required to bring a concrete mixture to a uniform degree of plasticity is a function of the surface area of the aggregate, the quantity of cement required to maintain this fixed water-cement ratio is likewise a function of surface area.

Conversely, if a fixed plasticity is maintained, and the cement content of the mixtures are constant, then the compressive strength varies with the surface area of the aggregate. Both of these points have been brought out nicely in the tests by Mr. Edwards.

Compressive Strength and Cement Content

In the writer's article published in the June 26th, 19 issue of *The Canadian Engineer*, the form of the theoretical relation between compressive strength and the cement content of a mixture was derived. The cement content was given in terms, of "pounds of cement per 100 sq. ft. of surface area," a unit which has been adopted by the Hydro-Electric Power Commission in all of its work. Figs. 9 to 12 show curves of the same form obtained from the experimental data of the investigators referred to, with the exception of Prof. Talbot. In the case of the tests of Figs. 9 and 12, the original results were obtained by other than the surface area method of proportioning. These curves are strikingly similar and are further evidence of the agreement between the data of the different investigators.

It is not within the scope of this article to discuss the relative merits of either the fineness modulus or the surface area methods of proportioning. Enough has been brought out, the writer believes, to show that they are simply different adaptions of essentially the same data.

Shortcoming of "Fineness Modulus"

The fineness modulus method of evaluating an aggregate has one serious shortcoming not present in the surface area method: It is dependent upon the number and sizes of the sieves used in its determination.

The surface area method is not so dependent; the same result can be obtained with any one of the commercial series of sieves in common use, because the surface area of an aggregate is a property of the material and not of both the material and the size and number of the sieves used in the sieve analysis.

A modification of Mr. Edwards' surface area method is being successfully applied by the Hydro-Electric Power Commission in the construction of several of its power developments. It is working satisfactorily and is giving better concrete with less cement than is being obtained on work where it is not in use. It is simple, and has been found easy to introduce into the field. It is not a panacea for all the ills of concrete, and its successful use requires careful inspection, intelligent supervision and a certain amount of laboratory assistance, but these are necessary with any method if good concrete is to be produced. It can be made to do all that is claimed for the "fineness modulus method," and it has certainly been found simpler to "put over" in actual field work.

*Presented June, 1919, before the American Society for Testing Materials; see *The Canadian Engineer*, November 6th, 1919, issue for summary of this paper.

Letters to the Editor

EFFECT OF RODDING CONCRETE

Sir,—Prof. F. E. Giesecke's tests on rodded concrete, reported in your August 14th issue, are of interest in showing the increased strength due to this treatment, and in illustrating the extent to which fresh concrete may be disturbed without adversely affecting its strength. The author properly attributes the increase in strength to the removal of the excess water by rodding.

The writer believes, however, that Prof. Giesecke is not on safe ground when he compares his tests directly with certain results from this laboratory, and depends on that comparison for a measure of the effect of rodding when using concrete of different consistencies. It is unfortunate that he did not make a parallel group of tests from which the water-ratio strength relation could have been platted for the unrodded concrete. (The water-ratio is the ratio of the volume of water in the batch to the volume of cement, considering cement to weigh 94 lbs. per cu. ft.) The strength of his concrete was probably different from ours, due to many factors which had no relation whatever to the effect of rodding. In other words, in his Fig. 1 the water-ratio strength curve for unrodded concrete may have been entirely different from the curve shown (which is based on certain of our tests), due to differences in the quality of the cement, temperature, curing conditions, time of mixing, or numerous other variations which affected all tests alike. The comparison of his earlier tests with our curve is not very convincing.

In our discussions of the water-ratio strength relation for concrete, we have pointed out that the constants in the formula quoted by Prof. Giesecke ($14{,}000/7^R$ where R is the water-ratio, an exponent) depend on the quality of the cement, age of concrete and other conditions of the test.

Other tests made in this laboratory give different values of these constants, although the general relation between water-ratio and strength has been found to hold true for different proportions of given materials so long as the concrete has water enough to make it plastic and the aggregate is not too coarse for the quantity of cement used.

Prof. Giesecke's Error

Prof. Giesecke has fallen into an error in plotting his tests in Fig. 1, since no allowance was made for the reduction in the water-ratio of the concrete as a result of rodding, due to one or more of the following factors:—

1. Working water to the surface, which escaped, and consequently did not influence the final water-ratio.
2. Evaporation due to long exposure of the cylinder during rodding.
3. Absorption of water by the aggregate during rodding.

Concrete which was originally mixed with a water-ratio of 1.00, may after rodding have a water-ratio of 0.7, consequently the strength should be platted with reference to the latter figure and not the former. In other words, the curves from Prof. Giesecke's tests should all be moved to the left, the exact position being unknown on account of the uncertain effect of rodding on the final water-ratio. If this were done, we would find a very different relation from that given by the original figure, and at the same time attribute the increase in strength to the proper cause; that is, the artificial reduction in the water-ratio.

The time of setting of the cement used in Prof. Giesecke's tests would have been of interest. Undoubtedly the plastic condition was quite different for the concrete which had been rodded for long periods than at the beginning. This should be borne in mind in considering applications of this method. It seems probable that the strength would have been quite similar had the concrete been permitted to stand for the periods shown, before being placed in the forms, provided that sufficient water were used in the beginning to provide a plastic mix after the absorption and evaporation had occurred.

In a series of tests carried out by the writer several months ago, a study was made of the effect on the strength of the concrete of using different methods of moulding the specimen. We were interested only in methods which could be used in moulding test cylinders in the laboratory. Compression tests were made on 6 by 12-in. cylinders at the age of 28 days, using sand and pebbles graded up to 1½ in. A 1: 5 normal consistency mix was used, with a water-ratio of 0.87. For 12 strokes of the ⅝-in. steel bar on each 4-in. layer of concrete, we secured a strength of 2,680 lbs. per sq. in.; for 25 strokes, 2,780; and for 50 strokes 2,810; an increase of about 4% for 25 strokes as compared with 12, and an increase of about 5% for 50 strokes as compared with 12.

The first and third values were the average of 5 tests; the second, the average of 15 tests made on different days. Puddling was done during the moulding of the specimen and the concrete was not subsequently disturbed.

Water-Ratio Determines Strength

These tests showed a comparatively slight effect due to the different number of strokes used on each layer. Twenty-five strokes for each 4-in. layer is the number regularly used in making our test pieces. It will be noted that the water-ratio of this concrete was not changed, consequently we would expect little effect due to the number of strokes, so long as the minimum number of strokes gave compact concrete. Several methods of tamping were also used. The same series covered a study of the effect of vibration, jigging and pressure. These tests brought out clearly that the increase in strength due to pressure on fresh concrete may be measured by the quantity of water which is forced out by the pressure. In other words, *it is the reduction in the water-ratio of the concrete which increases the strength.*

It is the writer's belief that much of the effect due to workmanship in handling and placing concrete can be traced to the influence of any particular practice on the final water-ratio of the mixture.

DUFF A. ABRAMS,
Professor-in-Charge,
Structural Materials Research Laboratory,
Lewis Institute.

Chicago, Ill., November 22nd, 1919.

EFFECT OF WATER UPLIFT ON OVERTURNING OF DAMS

Sir,—Replying to your comments in your issue of November 6th, regarding article on "Effect of Water Uplift on Overturning of Dams," the writer wishes to make a few explanatory remarks.

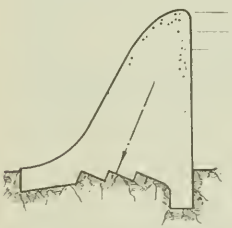

FIG. 1—GRAVITY DAM, ROCK FOUNDATION

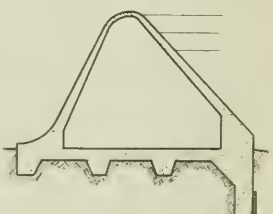

FIG. 2—REINFORCED HOLLOW DAM, EARTH FOUNDATION

Safety against sliding can be provided for in several ways: (1) Roughening between surfaces of contact; (2) increase in weight; (3) anchoring, by means of anchoring walls; (4) any combination of above.

Fig. 1 shows gravity dam section with rock surface roughened so that stability against sliding depends on shearing strength of concrete or rock.

Fig. 2 shows hollow reinforced dam section on earth foundation provided with toothing and anchoring wall. This method is comparatively new and has been described fully in the transactions of the American Society of Civil Engineers, December, 1917, in the article on the "Reconstruction of the Stony River Dam."

In both cases, Figs. 1 and 2, no concrete has been added to the amount required for stability against overturning, except in that in the second case a small amount of concrete was added to form toothing and anchoring wall. Inasmuch as this anchoring wall is merely an extension of a cut-off wall, but heavily reinforced and thicker, it serves two purposes—namely, (a) safety against sliding; and (b) increase in percolation distance in conjunction with sheet piling.

E. MAERKER.

Jackson, Mich., November 21st, 1919.

ECONOMIC STATUS OF GUARANTEES FOR PAVEMENTS ON ROADS AND STREETS*

THIS committee has very carefully considered the points brought up in the discussion of its progress report† during the annual convention held in New York, February, 1919, and in the technical press thereafter. It feels that certain of the criticisms of its report were based upon an incomplete understanding of its aim and scope, but realizes the difficulty of discussing a subject of this kind after listening to the reading of a somewhat lengthy and comprehensive report without having had opportunity to study it thoroughly

It has been suggested that it would be helpful if the committee were to indicate what it considers a proper period of reasonable life without repairs for various kinds of pavement under different conditions. An earnest effort to compile such a table, which would cover all possible conditions, clearly showed however that the wide variation necessary in a general schedule would render the figures worthless and would probably lead to a very heated discussion as to whether the figures cited were to be regarded as a measure of the life of various types of pavement when laid upon different kinds of foundations and subjected to traffic of various densities, and the attempt was therefore abandoned. Each set of conditions must be given individual consideration, and the committee believes that the determination of such reasonable periods in any particular case would not be extremely difficult and that any competent engineer can do this satisfactorily.

The committee's recommendation that the guarantee bond be supplemented by a cash retainer was based largely upon the difficulty sometimes experienced in having necessary repairs made within a reasonable time and was designed to provide a means of enforcing this necessary provision of any paving contract without first having to resort to a lawsuit. As a rule, a municipality has no fund available for this class of work and the cash retainer therefore serves two purposes:—

1. It tends to bring the contractor back to make the repairs, as he knows he will collect some money toward the expense involved.

2. It gives the municipality cash with which to make the repairs and thus avoids the necessity of going through the formalities and oftentimes difficulties of securing an appropriation, with all the attendant delays.

In this connection the committee recommended that a greater percentage be retained on resurfacing work as compared with new construction, in order to provide for approximately the same amount of retained money per square yard of finished pavement in both cases. This did not mean, as was assumed by some members, that the committee felt that resurfacing work, properly conducted, involved any greater guarantee liability than new construction work. On further consideration of the matter, your committee believes that reasonably adequate protection would be assured to the municipality by a reduction of the amount of the retained moneys from 10% to 20%, as at first recommended, to 5% and 8%, respectively. It further feels that such a provision cannot be justly held to be a curtailment of a contractor's working capital.

Fifteen Cents Per Square Yard

In arriving at this conclusion, your committee takes the position that fifteen cents per square yard to cover guarantee liabilities may be assumed as a fair average. On this basis the following figures may be considered as typical and illustrative of the principle involved:—

	Resurfacing.	New work.
Construction cost per sq. yd.	$1.50	$2.50
10% profit	.15	.25
Guarantee	.15	.15
Total	$1.80	$2.90
Retained (8%)	.15	(5%) .15
Payment on completion	$1.65	$2.75

In both cases the contractor receives a payment equal to his construction cost plus profit, the municipality retaining an amount practically equal to the sum included by the contractor in his bid as necessary to cover the guarantee provisions. This amount per square yard is the same for both types of construction and has not been expended by the contractor in his work and will not be expended by him except where defects in construction have occurred. While held by the municipality, the contractor will be paid interest on it. This amount, while sufficient to cover ordinary defects in workmanship and insure the making within a reasonable time of necessary repairs, is totally insufficient to cover extensive repairs rendered necessary by serious defects or failure of the work, protection against this being assured by the guarantee bond.

Your committee further believes that the criticism that its provision as to forfeiture of all retained moneys in case of failure to make ordered and necessary repairs is too drastic, is well founded and has modified its progress report in that respect by providing that the city may make these repairs at the expense of the contractor and such expense shall be deducted from the retained money. When any part of the retained money is due to the contractor, only such balance as has not been expended by the municipality shall be considered to be due and payable. When the cost to the city of such repairs exceeds the amount of retained money, the balance shall be recoverable from the sureties.

Amendments to Progress Report

It therefore submits as its final report, all of its progress report down to the paragraph commencing: "For new construction involving grading," etc., and adds thereto the following:—

"For new construction involving grading, foundation and wearing surface, we would recommend that an amount equal to 5% of the aggregate cost of these items be retained.

"For surfacing on an old foundation, we would recommend retaining an amount equal to 8% of the cost of surfacing.

"In the case of a two-year guarantee, the whole of the retained money should be payable at its expiration and not before. In the case of a five-year guarantee, one-fourth of the retained moneys should be payable two years after the completion of the pavement and the balance in three equal instalments. The date when payments of retained moneys become due shall be governed by the clause previously recommended for pavements completed and accepted between November 1st and May 15th.

"If the contractor, having received notice from the engineer, fails to make and complete the ordered repairs within a reasonable time (not to exceed thirty days in any case), the city shall have the right to undertake and complete the ordered repairs at the expense of the contractor or his sureties."

*Final report of committee (Francis P. Smith, consulting engineer, New York, chairman) to the American Road Builders' Association.

†Published in *The Canadian Engineer*, June 12th, 1919.

SIX HUNDRED MANITOBA "GOOD ROADSTERS"

Assembled at Joint Roads and Municipal Associations' Banquet to Consider Province's Future Highways Policy and Welcome President S. L. Squire

WINNIPEG has been definitely chosen as the meeting place for the annual convention of the Canadian Good Roads Association to be held the second week in June, 1920, S. L. Squire, president of the association, announced last week at a joint banquet of the Manitoba Good Roads Association and the Union of Manitoba Municipalities. Over six hundred were present, representing every organized municipality in Manitoba.

The speakers of the evening were Sir James Aikins, Premier T. C. Norris, Mayor Charles F. Gray (Winnipeg), S. L. Squire and several others. Sir James Aikins said:—

"At this gathering are representatives of all organized Manitoba, who show their spirit by action as well as words in the upbuilding of our system of roads. Roads are now recognized as one of our greatest necessities."

Most Successful Year in History

S. R. Henderson, president of the Manitoba Good Roads Association, acted as chairman. "Ten years ago the Good Roads Association of Manitoba was inaugurated," he said, "and since the drafting of the Good Roads Act great strides have been made in the development of our roads. This has been the most successful year in our history."

Premier T. C. Norris declared that "the Good Roads Association and the Union of Municipalities are among our two most useful organizations. We have representative men here—men who carry on the good government of our municipalities. Co-ordination and co-operation is shown in this gathering. The question of good roads is one of the great problems of the day. The time has arrived when we must have a 365-day road in Manitoba. It will be some time yet before we reach such a standard, but we are gradually working there. The main trunk roads of the province should be dealt with first, and then the market roads should be built up. It is the intention of the province to have trunk roads extending across the province within a short time. Large sums will necessarily have to be expended and they must be spent well. In order to maintain our position as one of Canada's foremost provinces, we must have good roads. Good roads will have a good effect on community life. It will result in more of our young people staying on farms and will continue farming as our basic industry. The people of Winnipeg are taking a great interest in the building of roads, and if Winnipeg progresses other parts of the province will progress also."

No Particular Types Recommended

Mr. Squire outlined the work of the association during the past few years. Winnipeg was chosen for the next convention, he said, because of the great interest taken by that city and the west in the development of the roads. "We do not say what kind of roads should be built," said Mr. Squire, "as long as they are good roads. Every dollar spent on roads is an investment for the country. We are past the experimenting stage.

"There is no such a thing as a permanent road. The only thing that is permanent is the location. Roads must continually be repaired. Roads must be built to take care of the traffic to which they are subjected. Expensive roads should not be built where there is little traffic, and cheap roads should not be built where there is a great deal of traffic. We have come to the time when the government must take over the initiative and lay plans for the building of roads. It is purely the work of the government.

"In the past roads have followed colonization, but we have reached the period when colonization must follow the roads, just as immigration follows transportation. The building of roads will fill up the vacant lands of the west and result in greatly increased production. It will be a good investment and will mean the upbuilding of the country. The people will support the government which lays a good system of roads throughout the province."

FROST HEAVES STREET RAILWAY PAVING SLABS IN EDMONTON

By C. L. De Vall
General Contractor, Edmonton, Alta.

CONSIDERABLE inconvenience, and some delays to Edmonton's street railway system were caused recently by the early "freeze-up." The triangular-mesh-reinforced concrete pavement between the rails was heaved for several inches by the action of the frost—enough to interfere with the gear casings of the street car motors, causing suspension of traffic until the heaved slabs were removed.

TRACTOR DERRICK LOADING THE SLABS

This condition, arising quickly, required prompt action by the city's officials. The slabs varied in length from 6 to 16 ft., the larger ones weighing about 1½ tons each, presenting a rather awkward bundle to handle on account of their shape and weight.

The first operation was to remove the slabs from their location between the rails and skid them to the curb; this was done to open the lines quickly and to find temporary storage for the obstructions, although in a measure they were still more or less obstructions for vehicular traffic. Special equipment was necessary to remove these slabs

UNLOADING AND PILING SLABS AT POOL

from the curb advantageously. A tractor hoist and derrick was secured from a local contractor, and with its aid the slabs were loaded on flat cars, special hooks being used for grappling the slab.

This work was necessarily carried on in the early hours of the morning and was suspended when the cars started running. The time available each night proved too short to make sufficient headway with the work, so teams and sleighs were secured and the work carried on in daylight, this proving to be the more satisfactory method.

The problem of salvage and disposal was partially solved by deciding to line the children's swimming pool at the park with the slabs, which work will use up a large quantity of the slabs. For the unloading, a small stiff leg derrick was used to pile the slabs in accessible locations convenient for rehandling when the time arrives to line the pool.

INLAND WATERWAYS CONFERENCE

WITH the object of obtaining an inland waterway suitable for ocean-going freighters and extending from the Atlantic Ocean to the head of the great lakes, an organization to be known as the "Canadian Deep Waterways and Power Association" was perfected at a two-day conference held November 18th and 19th at Windsor, Ont.

This conference was the first of its kind in Canada, and was attended by representatives from many cities throughout the Dominion. The opening address was by E. L. Cousins, chief engineer and general manager, Toronto Harbor Commission, who took as his subject, "What the Canalization of the St. Lawrence Means to Great Lakes Points." He spoke of the work Toronto is doing in developing its waterfront and stated that approximately $25,000,000 will be spent in deepening the bay and reclaiming marshland.

Already $19,000,000 has been expended by the city, several millions by the government, and several millions remain to be spent. The returns on the money invested for the past year were still less than the expenditure, but Toronto is not disappointed, and believes that the large investment has been well made. On land which a few years ago was only marsh and shallow water, factories are now located which employ upwards of 6,000 men, and Toronto estimates that an additional population of 20,000—a small city in itself—has been attracted to the city by the harbor improvements and the new industrial sites built up from waste land to attract manufacturers.

Until Canada extends her export trade, said Mr. Cousins, she cannot expect to get a full dollar's worth for a Canadian dollar, and her citizens would have the experience which he had had in Detroit of having to pay five cents to get a Canadian dollar changed.

Toronto had undertaken great harbor improvements because Toronto is the logical importing and distributing point for the province of Ontario, and because she needed deep draft vessels to call at her port to carry her manufactures chiefly to distributing points. Last year the imports of Toronto were $17,000,000 in excess of Montreal.

A British investor who recently opened a factory in Toronto had said he would not have located there had he not anticipated that in a very near day he would be able to load his own boat with raw materials at Swansea, and unload it at his own wharf at the door of his Toronto factory.

Toronto now controls 99 per cent. of its water front, an advantage which no other city in America possesses. Out of the total appropriation Toronto has spent $2,000,000 in parks and boulevards, preserving a part of its water front for the recreation of its citizens. The newspapers supported the project strongly, and even the railroads gave it encouragement.

Dwelling upon the wonderful natural resources of Canada still untouched, Mr. Cousins mentioned a new discovery of what he believes to be the greatest iron deposits in the world, near James Bay.

Since Toronto improved her harbor, private capital has invested over $5,000,000 in land that was formerly marsh and water. A New York amusement firm had offered millions for amusement privileges on one point of the reclaimed land which has been kept for park purposes.

The possibilities of the development of ocean commerce on the Great Lakes were discussed by C. P. Craig, of Duluth, secretary of the Great Lakes-St. Lawrence Tidewater Association; Hon. Frank H. Keefer, Port Arthur, under secretary of state for Canada; and R. J. McLean, Detroit, ex-director of the Atlantic Deeper Waterways' Association.

Mr. Craig pointed out that the Canadian Northwest must have a market, which could only be obtained when greater transportation facilities are provided for ever-increasing production. He urged co-operation between Canada and the United States in furthering the project of canalizing the St. Lawrence. He asserted that the deepening of the St. Lawrence would reduce the cost of carrying a bushel of wheat from Duluth to Liverpool from 15 cents to 9 cents.

Mr. Keefer thought that the time is not far off when waters of the Long Sault will be harnessed to supply light and power for the homes and factories of Michigan cities. He said that the governments of the United States and Canada have been so interested in railways, and the railways themselves have been so selfish, that development of the Great Lakes as highways for deep-water vessels has been overlooked. The problem of carrying the increased production of the local northwest, which, he said, the railways had wholly failed to meet, can only be solved by deepening the St. Lawrence.

With more than a million horsepower available by proper development of the St. Lawrence, there is no reason why the whole of Ontario and a great portion of the State of New York should not be using "white coal," thereby releasing many million tons of coal for use in other sections of the two countries.

At the afternoon conference November 19th, Sir Adam Beck spoke on power development. He stated that by means of deepening the Welland Canal to from 25 to 30 ft., and deepening the St. Lawrence at one or two points, 90 per cent. of all ocean-going vessels in the world would be able to traverse the Great Lakes freely.

The power possibilities of the St. Lawrence were unexceeded anywhere. For four years the Hydro Power Commission had had a skilled staff of engineers and investigators, in constant research and investigation, collecting information and data regarding the possibilities of this development.

For the whole Great Lakes-St. Lawrence development scheme, not much more than $100,000,000 would be required. To carry the coal used in this territory 285,000 cars were required. By building one dam and deepening a waterway to 30 ft., half a million carloads of coal would be saved by the power developed for Ontario and New York.

Ninety per cent. of all ocean-going vessels could traverse a passageway 24 ft. deep.

The building of the Morrisburg dam would make possible the control of the levels of Lake Ontario, with a regulation of from two to four feet. It would also increase the depth of Montreal harbor from two to three feet, while now at certain times of the year vessels cannot dock at Montreal for lack of six additional inches of water.

Remedial works would also increase the levels of Lake Erie from two to three feet and 50,000 second feet would be gained without impairing the scenic beauty of Niagara Falls. On the American side 20,000 second feet would be gained.

W. M. German, K.C., the newly elected honorary president of the Canadian Deep Waterways and Power Association, said that before the St. Lawrence river could be navigable for ships 600 ft. long and requiring a 30-ft. draft, the expenditure would amount to about $200,000,000.

A resolution calling for the joint undertaking of the deepening of the Great Lakes waterways for ocean-going shipping by the governments of the United States and Canada was moved by O. E. Fleming, of Windsor, and seconded by Clarence R. May, of London, Ont. The resolution follows:—

"That this association is of the opinion that the work to be undertaken in the deepening of the natural watercourses for ocean-going shipping should be undertaken by the governments of the United States and Canada jointly, and that it should be operated as a joint undertaking, so far as the watercourses may be international, and that the water powers of the St. Lawrence should be developed to their fullest extent for the purpose of producing a revenue, such revenue to be used to provide a sinking fund for the retirement of the capital expenditure, payment of interest and maintenance and operation of the canal system and hydro-electric operation; and that in this way, in our opinion, the project should be made self-supporting."

Recovery of Valuable Constituents of Garbage

Summary of the Various Methods of Disposal of Municipal Wastes, Including Hog-Feeding, Incineration, Sorting, Reduction, Alcohol Production, Etc.—Paper Read Two Weeks Ago at Annual Convention of American Society for Municipal Improvements

By SAMUEL A. GREELEY
Consulting Engineer, Chicago, Ill.

THE subject-matter of this paper covers a large and important field of municipal activity. It is not within its scope to reach many of the details of the processes required for the economic recovery of valuable materials from municipal refuse; the paper deals very largely with general principles and the limitations attending their application.

The term "valuable" is, furthermore, difficult to use with any degree of certainty under present market conditions Only the most careful consideration of local conditions, with projects tempered by a measure of flexibility, can justify definite conclusions.

Particular attention is directed to the importance of local conditions in developing methods of garbage disposal. Apparently satisfactory garbage disposal is obtained in one place by incineration, in another by hog feeding, another by reduction, etc. Matters of administration, stage of city development, past experience and training in garbage disposal, location, climate, character of population, topography, soil and many other factors are pertinent.

Fundamental Considerations

Broadly speaking, a method of final disposal of municipal refuse should serve three functions as follows: (a) It should render satisfactory service to householders; (b) it should be measurably clean and sanitary; (c) it should be reasonably economical.

In accomplishing these three ends, there are four parts, or phases, of the problem to be developed, as follows: (1) The house treatment; (2) the collection; (3) the transportation; (4) the final disposal.

The problem of garbage disposal is the proper development and adjustment of these parts of the problem to local conditions. The house treatment more directly affects the people; the collection is generally the more costly part of the work; transportation other than in collection wagons is needed only in the larger communities; while final disposal involves more engineering work and in general stimulates more discussion than the others. In the author's opinion each of the four phases is equally important, and a limitation of what follows primarily to disposal is not intended to eliminate or discard the influence of "house treatment" and "collection" upon the disposal.

Two other fundamental considerations are important, viz.: (a) The so-called relative values in sanitation; and (b) the fact that a successful handling of the refuse problem revolves primarily about operation.

By relative values is meant such items as, for instance, the stage of other municipal improvements possibly more directly affecting the public health, as well as the question of the proper cost of measures for eliminating odors not constituting a general nuisance. It is also obvious that "operation" looms large in refuse disposal work and must be given first consideration during the development of new works.

Valuable Constituents

Refuse is the term for the solid waste resulting from community activities as distinguished from sewage. Refuse is made up of garbage, ashes, rubbish, manure and many other materials. The valuable constituents contained in them are as many as the varied activities of the community These constituents may, however, be roughly classified by the disposal methods used to recover them, thus:—

1. Dumping, or land fill, makes the fullest use of the inert constituents of refuse not otherwise generally useful. Sometimes valuable land can thus be made.

2. Burial, or ploughing into the soil, makes possible the recovery of those constituents of refuse which are valuable for fertilizing the soil. Manure is quite generally disposed of in this way and some cities have developed its collection and transportation to farming districts very advantageously to the public comfort and the municipal pocket book. At Columbus, Ohio, a gross revenue of about $4,000 per annum is derived from the sale of manure. Street sweepings are also used in this way; sometimes, for instance, to cover dumps of mixed refuse for park purposes.

3. Mixed refuse can be burned at high temperature, producing steam suitable for power development, thus recovering or using the carbon and hydrogen contained in the refuse. With the increased demand for power, the higher price of coal and oil, and the gradual reduction in available close-by dumping areas, the value of refuse for steam production is increasing.

4. Garbage contains grease and tankage, both valuable constituents which are being economically recovered on a large scale by the reduction process.

5. From rubbish many marketable materials can be recovered, such as paper, rags, leather, old metals and the like. The process is commonly termed "rubbish sorting."

6. An old and universal method of recovering the valuable food constituents from garbage, is by feeding to hogs. This is one of the most interesting and useful methods of garbage disposal which has recently been given much prominence by war shortage of food.

7. There are many other processes for the recovery of valuable constituents from garbage which have been more recently studied, such as the production of alcohol and the preparation of a stock and chicken food.

Hog Feeding

For garbage alone, feeding to hogs is a method of disposal which undoubtedly has a wide field. By this method the food constituents of garbage are recovered in part. Some tests during an investigation of the refuse disposal problem made by the writer in Louisville, Ky., showed that 32.4 pounds of city garbage were required to add one pound to the weight of the hogs. The tests lasted seven weeks and covered observations on the feeding and growth of 25 to 40 hogs. The garbage was taken from several collection districts, but contained a somewhat smaller amount of other refuse materials than does much city garbage. With pork on the hoof at 15 cents a pound, the garbage would have a gross value of $9.26 per ton. It was actually sold by the city at that time (September, 1918), at $3 to $3.50 per ton for feeding to hogs.

At Worcester, Mass., where the separation of garbage is very good, it takes 37.5 pounds of garbage per pound gained by the hogs.

Hotel garbage has a higher food value. Mr. Gaumnitz, who feeds such hotel garbage in St. Louis, states that it takes only 25 pounds of such garbage to make one pound of gain on a hog; and this data is confirmed by tests at the Iowa Agricultural Experiment Station. At 15 cts. per pound of pork, hotel garbage should thus have a gross value for feeding purposes of $12 per ton.

From the gross indicated value of garbage for hog feeding, it is, of course, necessary to deduct plant operation, risk overhead, fixed charges, etc. These vary with the location of the hog farm, the value of the land, the climate, the length of the contract and the care with which the operation of the farm is conducted. In 1916, in connection with a study of

garbage disposal in Worcester, Mass., the writer estimated the total annual cost at $2.30 per ton, which was considered rather liberal at that time, but was predicted on an ample plant and good operation. As a matter of fact, contractors seem willing to pay not much over $1 per ton for city garbage, and in some cases less, some contract prices being as follows:—

Town.	Year.	Price paid by contractor to city per ton of delivered garbage.
Minneapolis, Minn.	1918	$1.26
Grand Rapids, Mich.	1917	0.45
Portland, Ore.	1918	3.90
Newark, N.J.	1919	1.20*
St. Paul, Minn.	1917	0.80
South Bend, Ind.		....
Anderson, Ind.	1917	1.00

*Figured at 8 times the pound price of live pork in Chicago.

The operation of hog farms is not an easy matter and varies considerably in different places, which may possibly explain the abandonment of hog feeding as a method of disposal in some cities. Of first importance is a superintendent who knows the feeding and care of hogs. But sanitary considerations are likewise important and must supplement the experience of the hog feeder. The more important items are:—

(a) Methods of feeding, (b) area required, (c) pens and runways, (d) vaccination, (e) disposal of unconsumed garbage, and (f) suppression of rats and flies.

The design will depend somewhat upon the location of the hog farm. For instance, in a report on hog feeding of garbage at Rockford, Ill., the writer recommended that "no garbage be fed to hogs in buildings closer than 300 ft. from a traveled roadway, and that garbage fed out of doors on platforms should be at least 600 ft. away."

Of paramount importance, however ,are matters of house treatment, frequency and adequacy of collection, and other items affecting the public comfort and the quality of the garbage.

Incineration

The carbon contained in refuse is a valuable constituent. The carbon content of garbage is low, generally less than 5%, and is not sufficient to warrant economical recovery. However, the carbon content of ashes and rubbish is higher, and so-called "mixed refuse" (garbage, ashes, and rubbish as collected from houses) contains as much as 20% of carbon. This gives it a value of about one-fourth that of coal (80% carbon), and as many municipalities are now paying upwards of $5 per ton for coal for pumping stations and lighting plants, the indicated gross value of a ton of mixed refuse is $1.25. Assuming an average evaporation of one pound of steam from and at 212 deg. F. per pound of refuse, this is equivalent to 6¼ cts. cost per 100 lbs. of steam, as compared with 4 cts. per 100 lbs. of steam used in the Milwaukee incineration tests in 1910.

A plant to burn mixed refuse should be especially designed for that purpose. The details of design cannot be taken up in this paper, but there are a number of plants which have been giving good service for periods up to 12 years as at Westmount, Savannah, Altanta, Milwaukee, West New Brighton and elsewhere. A record of power production at the Milwaukee refuse incinerator is shown in Table 2, and a record of operation of the refuse incinerator at Westmount, P.Q., in Table 1.

In projects for mixed refuse incineration, the effect (of collecting the refuse mixed) on the house treatment and cost of collection are important factors.

Rubbish Sorting

Rubbish contains much material which can be sorted out and sold, such as paper, rags, metals, rubber, shoes, and the like. During the war, the government urged that this should be done as a conservation measure, and there appears to be no reason why the practice is not good.

The gross value of rubbish varies with the market over a wide range. From 35% to 50% of the rubbish by weight can usually be recovered under normal city conditions. These materials bring in a gross revenue of about $2 per ton of rubbish on pre-war prices. The figures from the Columbus municipal rubbish sorting plant are given in Table 3. The selling price of rubbish materials in the Chicago market from quotations dated November 7th, 1919, are as follows:—

Metals—		
Copper	$ 0.16	per pound
Light copper	.15	" "
Brass—red	.16	" "
" —heavy yellow	.10½	" "
" —lighter yellow	.09	" "
" —yellow boring	.09	" "
" —red boring	.14	" "
Lead	.05¼	" "
Zinc	.05	" "
Mixed iron	12.00	per ton
Rags—		
Mixed rags	.03	per pound
Bagging	.02	" "
Paper—		
Newspaper	.70	per 100 lbs.
Mixed paper	.60	" " "

MILWAUKEE, WIS.

TABLE 2— POWER PRODUCTION AT REFUSE INCINERATOR,

Month, 1917.	Total k.w. hrs.	Month, 1917.	Total k.w. hrs.
January	3,466	July	86,404
February	.....	August	118,249
March	.....	September	107,057
April	59,160	October	59,607
May	32,985	November	16,884
June	32,072	December	.....
Year's total			515,794

Average percentage of refuse incinerated:—Garbage, 68.84; ashes, 26.49; rubbish, 4.49; manure, 0.17. Average evaporation per pound of mixed refuse, 1.626 lbs.

TABLE 1— FIXED CHARGES, OPERATING COST AND REVENUE OF WESTMOUNT, P.Q., REFUSE INCINERATOR

	1907*	1908	1909	1910	1911	1912	1913	1914	1915	1916
No. of tons of refuse..	10,704	13,641	14,331	15,280	17,008	20,878	18,731	23,800	20,800	19,500
Fixed charges:—				*COST PER TON*						
Interest	$0.19	$0.17	$0.19	$0.25	$0.25	$0.21	$0.23	$0.18	$0.20	$0.22
Sinking fund	0.04	0.08	0.06	0.08	0.07	0.05	0.05	0.04	0.05	0.05
Depreciation	0.13	0.12	0.15	0.21	0.21	0.17	0.17	0.15	0.15	0.17
Operating charges.	0.55	0.52	0.46	0.48	0.59	0.48	0.65	0.55	0.65	0.71
Total cost	$0.91	$0.89	$0.86	$1.02	$1.12	$0.91	$1.10	$0.92	$1.05	$1.15
Revenue	0.36	0.31	0.40	0.40	0.46	0.40	0.45	0.48	0.48	0.46
Net cost	$0.55	$0.58	$0.46	$0.62	$0.66	$0.51	$0.65	$0.44	$0.57	$0.69

*Ten Months.

Rubber—		
Automobile tires	.03	per pound
Tubes	.09	" "
Mixed boots and shoes	.07	" "
Arctic shoes (cloth covered)	.04	" "

A rubbish sorting plant comprises a receiving room and a wide belt conveyor travelling slowly up between two platforms on which the sorters stand. Along the outside of each platform are bins for storing the sorted materials. Below the bins are baling presses and other apparatus used to prepare the materials for shipment. An incinerator, usually with a boiler, is required to burn the unsorted rubbish. Such plants are in operation at Buffalo, Rochester, Pittsburgh, Columbus and elsewhere; and in many places rubbish materials are sorted on the dump and sold. The revenue from the sale of the sorted materials does not usually much more than pay for the cost of operation.

TABLE 3—REVENUE FROM COLUMBUS, OHIO, MUNICIPAL RUBBISH SORTING PLANT

	1917.	1918.
Bottles	$ 365.21	$ 116.33
Paper	1,859.06	1,876.06
Iron	145.53	58.19
Rags	579.94	239.45
Cans	452.59	1,600.31
Metal	114.39	5.50
Miscellaneous	5.03	28.26
	$3,521.75	$3,924.10

Reduction of Garbage

Reduction of garbage is a chemical and mechanical process whereby the garbage is separated into four parts, viz.: Volatile matter driven off as gas; water; grease; and dry material which is somewhat stable, mostly fibrous, and of vegetable and animal origin, and called "tankage." The grease and tankage have market values.

TABLE 4—VALUE OF PRODUCTS FROM GARBAGE

Market price of grease, per pound.

Year.	Chicago.	Cleveland.	Columbus.
	Cts.	Cts.	Cts.
1913	....	4.26	3.73
1914	....	4.17	4.32
1915	....	4.41	3.76
1916	7.29	6.50	5.17
1917	7.34	8.00	7.50
1918	11.57	13.50	11.76
1919	....	5.0 to 7.6	.....

Market price of tankage, per ton.

Year.	Chicago.	Cleveland.	Columbus.
1913	....	$6.00	$6.79
1914	....	6.75	7.41
1915	....	8.75	7.00
1916	$4.16	7.75	8.50
1917	4.16*	9.58	10.84
1917	10.27**	....	.....
1918	10.27*	18.50	20.50
1918	16.85**	....	.....
1919	.....	10.00	.....

*To August 1st. **Balance of year.

The amount of these materials which can be recovered depends upon the character of the garbage and the process used for recovery; 2½% of grease and 11% of tankage by weight of raw garbage may be recovered. The gross value of these constituents depends upon the market price, which varies greatly, as shown in Table 4. The present market price of grease is about 6 cts., and of tankage about $10 per ton, which would indicate a gross value of garbage for the reduction process of $4.10 per ton. During the war these prices were doubled.

Many processes have been devised for reducing garbage, cost of which fall into one of three groups designated as follows:—Drying method, cooking method, and Cobwell process.

The Cobwell process is the most recent and may be described as the "dehydration, or drying, of the garbage by cooking at low temperature while immersed in a solvent, the extraction of grease from the dried garbage by the same solvent, the recovery of the solvent for further use, and the production of grease and dry tankage for the market." Almost all of the action takes place in closed reducers and the connections. At New Bedford, Mass., the recovery by the process is stated to be 4% of grease and 15% of tankage, and at Los Angeles, Cal., 15.5% of grease and 3.1% of tankage.

TABLE 5—MATERIALS RECOVERED AT CLEVELAND AND COLUMBUS REDUCTION PLANTS

Cleveland

Year.	Total tons of garbage reduced.	Percentage of total garbage recovered. Grease.	Tankage.
1905	30,382	2.63	....
1906	34,891	3.07	....
1907	37,606	3.14	....
1908	41,242	3.46	9.2
1909	44,525	3.70	11.3
1910*	44,747	3.75	13.2
1911	46,562	3.53	12.8
1912	43,555	3.38	11.5
1913	52,384	3.13	9.7
1914	55,730	2.95	10.5
1915	66,271	2.81	10.4
1916	63,450	3.06	11.2
1917	56,121	2.73	11.3
1918	57,254	2.36	11.0

Columbus

Year.	Total tons of garbage reduced.	Percentage of total garbage recovered. Grease.	Tankage.
1911	17,534	1.85	12.9
1912	18,789	2.72	11.6
1913	20,711	2.72	10.5
1914	21,629	2.73	9.7
1915	22,909	2.21	10.0
1916	21,862	3.08	10.3
1917	17,127	2.26	10.21
1918	15,630	2.16	10.26

*At Columbus operation was begun in July, 1910, and there was no percolation until January, 1912.

In the drying method, the garbage is first dried and then degreased in naphtha percolators. The grease recovery is comparatively low and the tankage recovery somewhat higher than in other processes. At the Chicago reduction plant, which uses the drying method, the percentage of grease recovered is 2.0, and of tankage 22.7, for the year 1918.

The cooking method comprises a first cooking of the garbage with live steam under pressure, then pressing out the free water and grease, then drying the pressed material, and finally recovering additional grease by percolation with a solvent. This process is used at Cleveland, Columbus and elsewhere. The percentage of grease and tankage recovered is shown in Table 5. Garbage reduction plants are usually located at some distance from built-up districts, which requires a transportation of the garbage. This and other local factors, such as size of city, should be considered in connection with this method of disposal.

There are, in addition to the more generally used methods mentioned above, several comparatively new methods not yet tried out on a very large scale. The Union Poultry Food Co.,

of Los Angeles, have a process which consists in placing the garbage, as collected, in a direct heat steam dryer. The dried product, which amounts to about 18% by weight of the garbage, is sold for poultry food, bringing as high as $40 per ton. This would indicate a gross value of the garbage of $7.20 per ton. The process has been considered at Kansas City, Mo.

A process for the production of alcohol from garbage, under patents held by Dr. S. J. Morgan, has been tested (1916) on an experimental basis at Columbus, Ohio. These tests showed a possible yield of 4.8 gals. of alcohol per ton of garbage, which, at 40 cts. per gallon, indicates a gross value of $1.92 per ton of garbage. It appeared from the tests that the recovery of grease and tankage was not materially affected by the alcohol recovery process.

There are, of course, other processes, such as that of Dr. Marsh, recently considered at St. Louis, which the inventor guarantees will yield "at ordinary market prices" not less than $3.60 per ton of garbage; the "Nufuel" or "Oakoal" process for making fuel briquettes; and others.

Summary

The writer does not feel justified in offering any conclusions in this paper except that garbage disposal should be considered with a view, where possible, to an economic recovery of valuable constituents. The lure of profit, however, should not overshadow the development of operation for the convenience and comfort of the householder and for the economy of collection.

It is a mistake to arouse public opinion on the matter of disposal where other parts of the problem are of equal importance and sometimes more costly. Nevertheless, economy of operation, elimination of waste, the salvage of useful and essential materials, are matters of vital importance in the present development of society, and the skill and efficiency with which they are done will reflect the general progress of the community.

This means that the economic value of valuable constituents of garbage and other refuse materials must be considered with the house treatment and collection, first cost of plant, overhead and fixed charges, and costs of operation. When and where the problem is approached in this broad, sound way, the writer believes that methods of disposal involving the recovery of valuable constituents will endure and will permit of operation without the interruptions and changes of method which now occasionally occur.

The Mechanical Engineering Department of the University of Manitoba, Winnipeg, Man., requests all firms manufacturing mechanical machinery and apparatus of all kinds to place the department on their mailing lists for catalogues, bulletins, etc.

Boynton & Williams, dealers in contractors' supplies, have moved to new and larger offices and warerooms at 42 Lombard St., Toronto. George P. Beswick, secretary of the Purchasing Agents' Association, and for twenty years with the Polson Iron Works, Toronto, has been appointed office manager and purchasing agent of the Boynton & Williams organization. At the new warehouse a large stock of pipe, valves and fittings is being carried. The firm also acts as representatives for a number of American manufacturers, and deals in new and used machinery.

In a circular letter sent to water companies and departments by the American Water Works Association, the formation of the American Committee on Electrolysis is announced, with representatives from water, electrical and railway engineers' and gas associations, etc., the purpose of this committee being to gather and classify information regarding electrolysis and to study and report on methods of construction and means of mitigation. The committee will co-operate with the Bureau of Standards in carrying out experiments and investigations and it is proposed that Prof. Lewis Allen Hazeltine, of Stevens Institute, should serve as a technical expert on the consulting board, on behalf of the interests of the water companies and departments. Subscriptions towards a fund of $3 000 to finance this work are now being solicited.

NO ROOM FOR TRADE UNIONISM IN ENGINEERING PROFESSION, SAY DIRECTORS OF AMERICAN ASSOCIATION OF ENGINEERS

FOLLOWING is a statement that has been issued by the executive committee of the American Association of Engineers, setting forth the position of that association in regard to trade unionism in the engineering profession:—

Reason for Statement.—In the present state of industrial unrest, the Board of Directors of the American Association of Engineers considers it desirable to make a statement defining the position of the association.

Responsibility.—The American Association of Engineers is an incorporated organization responsible for its acts.

Economic Position of the Engineer.—The engineer is the medium through which both capital and labor are used in production and in industrial development. The aim of the profession is to advance civilization and render the highest service to society. Except when their acts further this aim, it is an advocate of neither capital nor labor.

Increased Production.—Production should be increased—not limited. The profession cannot support strikes or lockouts or any other methods that may benefit any class at the expense of the nation as a whole. They are unsound and must inevitably lead to economic disaster. The law of supply and demand for men or material must ultimately prevail. Attempts may be made to limit the supply of either, but looking toward the upbuilding of civilization, we believe rather in increasing the demand through the promotion of legitimate enterprises.

Reward According to Merit.—Rewards should be according to ability, initiative and constructive effort. Men are not equal in these respects. Each man should be encouraged to do his utmost and be given compensation according to ability and will to increase production and to achieve large results.

Methods.—The engineer, as an educated professional man, believes in basing his claims for proper and just reward for his services upon the justice of the facts presented, upon enlightenment of public opinion, upon loyalty between employer and employee, and upon the underlying fundamental desire of the great majority to do what is fair and right when the merits of the case in question are clearly presented and demonstrated. We believe in organized representation for the correction of wrong, the advancement of the profession and service to the public, but are opposed to methods inconsistent with the dignity of the profession and which would lessen public confidence.

Conclusion.—The American Association of Engineers, through its Board of Directors, who have signed this statement, recognizing the many fundamental differences between the principles and objectives of the trade union and of an organization of professional men, expresses the opinion that an engineer cannot subscribe to the tenets of both.

Signed by Dr. F. H. Newell, head of department of civil engineering, University of Illinois; W. W. DeBerard, western editor, Engineering News-Record, Chicago; T. A. Evans, assistant engineer, Jacobson & Schraeder, Chicago; R. Burnham, consulting engineer, Chicago; W. W. K. Sparrow, chief engineer C. M. & St. P. Ry., Chicago; Harold Almert, consulting engineer, Chicago; J. N. Hatch, consulting engineer, Chicago; F. K. Bennett, principal assistant engineer, M. & St. L. Ry., Minneapolis; H. W. Clausen, general office manager, C. D. Osborne Co., Chicago; C. A. Soans, patent attorney, Chicago; W. D. Wilcox, past president, American Association of Engineers; L. K. Sherman, U. S. Housing Corporation, Washington, D.C.; Isham Randolph, consulting engineer, Chicago; Alexander Potter, civil engineer, New York; E. F. Collins, valuation engineer, St. L.S.F. Ry., St. Louis; C. H. Crawford, manager, Baldwin Locomotive Works, Philadelphia; John Ericson, consulting engineer, Department of Public Works, Chicago; and C. E. Drayer, secretary, American Association of Engineers.

(NOTE.—Since the above statement was received, we have been advised by C. E. Drayer, secretary of the American Association of Engineers, that all of the other directors of the association have added their signatures to the statement, making it unanimous.—EDITOR.)

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AWARD HIGHWAY CONTRACTS EARLY!

IN a letter addressed to the heads of the State Highway Departments, Thomas H. MacDonald, chief of the Bureau of Public Roads, United States Department of Agriculture, urges the state departments to place under contract during December and January as great a mileage of roads as possible.

Mr. MacDonald estimates the amount of money available for road work in the United States during 1920 to be $633,000,000, or more than four times as much as has been expended during any previous year for like purposes. He calls attention to the lack of open top cars for transporting road materials, and says that this deficiency must be made good by using these cars more efficiently and by awarding contracts sufficiently early to permit contractors to obtain their materials during the season when the open top cars are not in the greatest demand.

Last spring the number of open top cars that were idle in the United States was estimated at over 250 000, but as the season advanced and road contracts were actually under way, acute car shortage manifested itself generally throughout the country.

Should the movement of coal demand the cars, or should there be any railroad labor trouble, highway work would be sadly interfered with in case the contracts are awarded too late, inasmuch as road materials are not perishable and are among the last things that would be moved on the rails.

What Mr. MacDonald says in regard to conditions in the United States applies with equal or greater force to Canada. The placing of materials in storage piles involves some expense, but this cost is small in comparison to the loss occasioned by the lack of materials when the contractor's organization is waiting. Contracts which are not awarded during the winter months may have little opportunity of being supplied with materials which require railway transportation.

Another good feature of the early award of highway contracts is that the contractors are encouraged to place their orders early, and material producers are given an opportunity to operate their plants during all seasonable weather. Not only does this help the car shortage, but it generally results in lower prices.

THE ASPHALT ASSOCIATION

THOSE who are interested in the movement for better roads and streets in Canada will note with pleasure the strong engineering staff which is being built up by the Asphalt Association. As is now undoubtedly well known by the readers of our paper, this association was formed a few months ago by a number of competing asphalt producers for the purpose of ensuring not only the widest possible use of their product, but also the most efficient use. In forming an association of this kind for general promotion and research work, the asphalt producers are merely getting into line with the service policy that is now rapidly being adopted by all industries that are conducted upon the best business principles.

Highway engineering in Canada will undoubtedly benefit by the formation of the Asphalt Association. The service which its engineers and laboratories can render will not be any the less appreciated for the fact that these engineers are at the same time promoting the sale and use of asphalt. All service has a *raison d'être*, and good service, whether in engineering or other fields, is always entitled to recognition and reward. The service which the Asphalt Association will render will undoubtedly be met with a marked increase in the use of that material.

The officers of the Asphalt Association indicate its high standing in point of responsibility for data published, and also its independence from a competitive standpoint. They are as follows:—

President, J. R. Draney, of the United States Asphalt Refining Co.; vice-president, W. W. McFarland, of the Warner-Quinlan Asphalt Co.; treasurer, N. G. M. Lykx, of the Freeport Mexican Fuel Oil Co.; secretary, J. E. Pennybacker, formerly secretary of the U. S. Highways Council and formerly of the U. S. Bureau of Public Roads; chief of research department, Prevost Hubbard, former chief of tests and research of the U. S. Office of Public Roads.

The intimate relation which both Mr. Pennybacker and Mr. Hubbard have had with the good roads movement on this continent for the past fifteen or twenty years is too well known for them to need any introduction to Canadian engineers. Bruce Aldrich, the engineer who will be in charge of the affairs of the association in Canada, is not so well known in this country, but among engineers in the United States, particularly in the south, his experience and ability have long been recognized. His work in connection with street improvement and maintenance in Baltimore has well trained him for his new duties. Mr. Aldrich will not endeavor alone to solve the many paving and other problems which may be placed before him, but will merely serve to a certain extent as a link between the Canadian territory and the authoritative laboratory and engineering facilities which the Asphalt Association is rapidly establishing.

AMERICAN ASSOCIATION OF ENGINEERS

REMARKABLY rapid has been the growth of the American Association of Engineers. Founded in 1915, this association had a membership of approximately 250 at the beginning of 1916, 750 at the beginning of 1917, 1,500 at the beginning of 1918 and 2,500 at the beginning of this year. The membership of the association last Thursday was 8,866, and the officers have arranged a membership drive, to be carried out the first two weeks of December, which will undoubtedly boost the number to five figures.

Compared with the growth of the four main engineering societies in the United States, the American Association of Engineers has had a record-breaking career. It now has about

1,500 more members than has the American Institute of Mining and Metallurgical Engineers, and it has practically the same number as the American Society of Civil Engineers; moreover, it is only about 1,000 short of equalling the membership of either the American Institute of Electrical Engineers or the American Society of Mechanical Engineers. All four of these societies were, of course, founded many years ago, and have a tried and established membership which is immune from any fluctuations such as may or may not occur in the membership of the American Association before that organization is as old as is any of the other four societies.

During the past 10½ months the American Association of Engineers has grown almost as much as has the average membership of the other four societies during the last 17 or 18 years. The executive committee of the association express confidence that their organization will be the largest engineering society in the United States before the end of this year.

PERSONALS

PAUL EMILE MERCIER, consulting engineer to the Administrative Commission of the city of Montreal, who was recently appointed as a professor on the staff of L'Ecole Polytechnique, Montreal, and who will hereafter devote a considerable portion of his time to educational work, was born March 15th, 1877, at St. Hyacinthe, P.Q. He was educated at St. Mary's College, Montreal, and received his technical training at L'Ecole Polytechnique. He became chainman on the Montreal Park & Island Railway in 1895. Entering the service of the C.P.R. in 1896, as a rodman on the Quebec division, he became a leveller in 1897. In 1898, he joined the staff of the Public Works Department of Canada, as an assistant engineer, and from 1899 to 1904 was a district engineer in that department. In 1905 his services were requested by the National Transcontinental Railway, and for the following two years he was engineer in charge of that project. In 1908 Mr. Mercier engaged in private practice in Montreal, under the firm name of Baulne & Mercier, which connection was retained until 1914, when he was appointed deputy chief engineer of the city of Montreal. When George Janin, chief engineer of the city, was given leave of absence to go overseas in December, 1914, Mr. Mercier became acting chief engineer, and upon Mr. Janin's death in 1915, Mr. Mercier was appointed chief engineer. In May, 1918, he became the city's Director of Public Works, from which position he retired in November, 1918, to act as consulting engineer to the newly-appointed Administrative Commission. Mr. Mercier is a member of the Engineering Institute of Canada, the American Railway Engineering Association, the American Society of Civil Engineers and the Society of Civil Engineers of France.

A. P. MILLER, of Glenmiller, Ont., has been appointed assistant engineer on the Trent Canal staff, Department of Railways and Canals.

B. H. PRACK, industrial architect and engineer, has moved his Toronto office from the Lumsden Building to the Otis-Fenson Building, where he is now occupying the entire top floor.

PROFS. NORMAN BOWEN and CECIL GREENLAND, of the Faculty of Science, Queen's University, have resigned. The former is going to Washington, D.C., while Prof. Greenland is leaving for South America.

W. G. H. CAM has been appointed power engineer for the Canada Cement Co., Ltd., Montreal. He was formerly engaged in the design and construction of lighting and power systems in Montreal and vicinity.

ARTHUR SANDE, consulting engineer, has established an office in the Lister Building, Hamilton, Ont. Mr. Sande will specialize in buildings and equipments for industrial plants, hydro-electric developments, pulp and paper mills, steel mills, foundries, etc.

LT.-COL. CHAS. G. DU CANE, O.B.E., who was engaged all last summer on work connected with the Madras docks and harbors, and who has just sailed for London, Eng., to complete his report, will return to Vancouver in January to resume business with his former firm, Du Cane, Dutcher & Co., consulting engineers, who have in hand a number of new and important projects.

GUY MORTON, formerly Alberta manager for the Canadian Westinghouse Co., Ltd., has organized "Electrical Engineers, Ltd." at Calgary, Alta. Mr. Morton's new firm will deal in electrical and mechanical engineering equipment. He is a graduate of the University of Toronto in mechanical and electrical engineering, class of 1909, and served overseas as a lieutenant, returning to Canada only four weeks ago.

J. A. OWENS, who graduated in civil engineering at the University of Toronto, class of 1914, has joined the staff of J. B. Nicholson, Ltd., of Toronto and Hamilton, as resident engineer on reinforced concrete construction in Toronto. Mr. Owens was formerly with Wheelock & Christie, consulting engineers and surveyors of Orangeville, Ont., and for the past few months has been in the employ of James, Loudon & Hertzberg, Ltd., consulting engineers, Toronto.

PROF. L. W. GILL, of Queen's University, Kingston, Ont., has been appointed Director of Technical Education, Department of Labor, Ottawa. This directorate is a new office the creation of which was made necessary by the action of parliament in voting $10,000,000 to be spent on the encouragement of technical education throughout Canada. The money for the most part is to be spent by the provinces on the basis of agreements to be reached with the provincial governments, in much the same manner as federal votes in aid of agriculture have been distributed. Prof. Gill served with the Canadian forces overseas, in command of the 46th Battery. He has been head of the electrical engineering department of Queen's University for the past fifteen years.

ONTARIO PROVINCIAL DIVISION, E. I. C.

TWENTY-SIX engineers, representing the various branches of the Engineering Institute of Canada throughout Ontario, met last Friday afternoon and evening at the Engineers' Club, Toronto, as delegates to the first formal conference of the institute's Ontario Provincial Division. J. B. Challies, of Ottawa, chairman of the division, presided.

The most important decision reached was that a joint committee of twelve men be formed to consider legislation for Ontario, the division to name two of the twelve and two to be named by the Ontario branches of each of the following five organizations: The Canadian Mining Institute, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, the Canadian Institute of Chemistry and the Ontario Association of Architects.

The other matters discussed were solely internal affairs of the institute, chief of which was a recommendation to the council of the institute that Ontario be divided into three districts instead of two, so as to give Western Ontario larger representation on the council.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand or proposed, contracts awarded, changes in staffs, etc.

ADDITIONAL TENDERS PENDING

Not Including Those Reported in This Issue

Further information may be had from the issues of *The Canadian Engineer*, to which reference is made.

PLACE OF WORK	TENDERS CLOSE	ISSUE OF	PAGE
Biggar, Sask., erection of Nurses' Home and Isolation Hospital	Nov. 28.	Nov. 13.	46
Chippawa, Ont., highway bridge.	Dec. 6.	Nov. 20.	54
Crowland Tp., Ont., water mains	Dec. 18.	Nov. 20.	46
Hamilton, Ont., reinforced concrete pipe	Dec. 1.	Nov. 20.	45
Lakefield, Ont., rebuilding dam.	Nov. 29.	Nov. 20.	52
Montreal, Que., briquetting machinery	Dec. 14.	Nov. 6.	54
Windsor, Ont., erection of school	Nov. 29.	Nov. 13.	50
Winnipeg, Man., six 1,000 k.v.a. step-down single-phase transformers	Dec. 1.	Nov. 13.	45

BRIDGES, ROADS AND STREETS

Barton Tp., Ont.—Township council will reconstruct two roads. Clerk, A. G. E. Bryant, Mount Hamilton, Ont.

Cayuga, Ont.—The ratepayers passed a by-law to raise $10,000 for good roads. Clerk, R. S. Coulter.

Chippawa, Ont.—Time for receipt of tenders by the Hydro-Electric Power Commission of Ontario, 190 University Ave., Toronto, for Chippawa Highway Bridge has been extended to 12 o'clock noon, December 6th, 1919.

Lindsay, Ont.—Scott's Creek bridge, on the boundary of Victoria and Ontario counties, will not be built until next year.

Cleveland, Que.—Tenders for gravelling parts of the Spooner Pond and Craig's Rd. will be received up to December 1st, 1919. Plans and specifications may be obtained on application at the secretary's office, Richmond, Que.

Cornwallis, Man.—On December 16th electors will vote on by-law to borrow $100,000 on debentures for the construction and improvement of roads. Secretary-treasurer, D. W. Shaw, Brandon, Man.

Hamilton, Ont.—Plans for a new cemetery include the macadamizing of 1,700 yds. of roadway, at a cost of $11,000; the filling in of 2,000 feet of roadway and the erection of a concrete bridge, at a cost of $35,000, or a total of $46,000. Chairman Cemetery Board, Mr. Peebles.

Hampstead, N.B.—Contract for the construction of the Little River (Mouth) bridge has been awarded to the Concrete builders, Ltd., of Fredericton. The bridge is to have a reinforced concrete arch span with concrete abutments. The contract price is about $37,000.

Kitchener, Ont.—City council may extend Homewood Ave.

St. Andrew's, Man.—By-law will be submitted to electors on December 16th providing for the construction of a system of roads and improvements. Estimated cost, $424,728. Clerk, J. D. Forster, Clandeboye, Man.

St. John, N.B.—City council adopted recommendations that plans and specifications be prepared for paving with bituminous concrete the whole of Douglas Ave., City Rd., Brussels St. and Marsh Rd. City engineer, G. N. Hatfield.

St. John, N.B.—City council let contract to Morrison and Newlands for 50,000 granite blocks at $87.50 per thousand.

St. Thomas, Ont.—City council intends to construct an asphalt pavement on Talbot St., from Mary St. to Balaclava St., with concrete curb and gutter on each side of the street. The estimated cost of the work is $98,327. City clerk, W. B. Doherty.

St. Thomas, Ont.—London and Port Stanley Railway Commission will commence work immediately on the erection of a bridge over Kettle Creek. Vice-chairman, Philip Pocock, London, Ont.

Toronto, Ont.—Works Commissioner Harris has recommended the construction of a bitulithic pavement on Amroth Ave. at a cost of $18,093.

Toronto, Ont.—City council intends to grade Bellefair Ave. at cost of $3,400, and extend Redpath Ave. at cost of $9,850. City clerk, W. A. Littlejohn.

Toronto, Ont.—Board of Control referred to the Property Committee a proposal to cut a street through the jail property across the corner from Broadview Ave. to Gerrard St.

Toronto, Ont.—R. C. Harris, Commissioner of Works, recommended opening of lane between St. George and Huron Sts., southerly from Dupont St. Estimated cost, $2,300. Works committee recommended adoption of this report.

Toronto, Ont.—City council intends to construct asphalt pavements on Gerrard St. and Swanwick Ave. at cost of $2,191.61; concrete curbings on Gerrard and Keele Sts., cost, $1,530; extend Norway Ave. at cost of $40,000, and grade Hillingdon Ave. at cost of $9,605.

Toronto, Ont.—Board of Control let contract for supply and delivery of material for canopies over sidewalks under subways at King St., Queen St., and Lansdowne Ave., to the A. B. Ormsby Co., Ltd., Toronto, at $3,441.60 total, material to be keystone copper bearing steel sheets.

Toronto, Ont.—Works Commissioner Harris recommended the construction of the following pavements: Devon Rd., from Cassels St. to Gerrard St., asphalt, $10,418; Evelyn Ave., from Glendonwynne to Evelyn Cres., bitulithic, $6,621; Willard Ave., from Bloor to Colbeck, bitulithic, $26,295; Colbeck St., from Windermere to Jane, bitulithic, $25,571.

Toronto, Ont.—Works Committee recommended the construction of the following: An asphalt pavement on Lyall Ave. at a cost of $32,749; the resurfacing with asphalt of both sides of Spadina Ave., between King and Adelaide Sts., at a cost of $8,295; an asphalt pavement on Teraulay St., Dundas to College St., at a cost of $42,218; a permanent pavement on Amroth Ave. at a cost of $18,093.

Winnipeg, Man.—Applications from eight provincial municipalities for roadwork under the Good Roads Act have been approved to the amount of more than $1,000,000.

Winnipeg, Man.—The Parks Board will call a meeting of representatives from the municipalities of Charleswood, Tuxedo, Assiniboia, Macdonald and Rosser to discuss the erection of a new bridge at Assiniboine Park.

Winnipeg, Man.—Hon. George A. Grierson, Provincial Minister of Public Works, announced that survey work for the construction of a 40-mile summer road to the Rice Lake gold fields would start early in January. The estimated cost

of a bridge in this connection over the Winnipeg river is $350,000, and the cost of the road is estimated at approximately $80,000.

York County, Ont.—Work on rebuilding the Baldwin bridge may start soon. Estimated cost, $22,019.

WATER, SEWAGE AND REFUSE

Beaverton, Ont.—Report submitted by the E. A. James Co., Ltd., Toronto, on proposed waterworks system, estimated to cost $85,000, which includes intake into Lake Simcoe, filtration plant, pumps, elevated tower and mains. Council decided to take vote of people in February, 1920.

Burlington, Ont.—Tender of S. Oakes for house sewer connections on St. Paul, Green and Caroline Sts. were accepted by town council.

Forest, Ont.—Report submitted by the E. A. James Co., Ltd., Toronto, on waterworks system, estimated to cost $62,000, which includes mains, pumps, water tower and deep well. Council decided to submit same to vote of people, January, 1920.

Guelph, Ont.—City council passed a by-law providing for the construction of sewers on York Rd., Havelock, Toronto, Inkerman, Duke, Harris and Alice, Ferguson and Metcalf Sts. City engineer, F. McArthur.

Hamilton, Ont.—City engineer E. R. Gray presented to the board of control an extensive overflow sewer scheme, the central and western portions of which are estimated to cost in the neighborhood of $1,500,000.

Hamilton, Ont.—City council intends to construct pipe sewers on Paradise Road and Roxborough Ave., at a cost of $3,275.28. Also pipe sewer on Burlington St., cost, $41,335.51. City clerk, S. H. Kent.

North Bay, Ont.—Tenders will be called for improving, altering and extending sewers in Worthington and Sherbrooke Sts. involving 6,000 ft. 30 in. reinforced concrete pipe. Cost, $25,640. Town engineer, H. J. McAuslan.

Peterboro', Ont.—City council intends to construct a sewer on Dublin St. City engineer, R. H. Parsons.

Sudbury, Ont.—Plans have been prepared and estimates are being obtained for the proposed completion of the west end sewer system. Mayor, P. Morrison.

Toronto, Ont.—Works Commissioner R. C. Harris will prepare a report on a water service for the eastern district of York.

Toronto, Ont.—Construction of relief sewer from south end of Campbell Ave., westerly to Symington, is considered necessary by Works Commissioner R. C. Harris.

Toronto, Ont.—Works Commissioner Harris reported to Board of Control that it will be necessary to replace four of the electrically driven pumps which supply the city with water before next summer. The cost is placed at $75,000. Tenders will be called.

Welland, Ont.—City council will have water main laid to River Road. City engineer, Chas. L. Coulson.

Welland, Ont.—City council let contract for the construction of the Smith Street sewer to A. D. Brown at a cost of $3,083.33. Other tenders were received as follows: Louis Sacco, $4,438.98; Somerville and Dillworth, $3,259.99. The city engineer's estimate of the job was $2,590.

Windsor, Ont.—Plans of the Essex Border Utilities Commission to consolidate the waterworks systems of Windsor and Walkerville to supply the five border municipalities with filtered water at cost will be submitted to the ratepayers in January. The project will involve $2,000,000.

Winnipeg, Man.—Tenders, addressed to the chairman of the Committee on Fire, Water, Light and Power, will be received at the office of C. J. Brown, city clerk, up to 3 o'clock p.m., Monday, December 15th, 1919, for the supply of hydrants and valves for the Domestic Waterworks System. Specifications may be obtained at the office of the city engineer, 223 James Ave.

LIGHT, HEAT AND POWER

Kingston, Ont.—The A. F. A. Coyne Co. has been granted a franchise for the supply of natural gas to Athabaska. The agreement calls for the placing of the pipe lines by May 1st next, and the completion of the whole system by October 1st.

North Battleford, Sask.—Tenders addressed to Robert Farquharson, city clerk, and marked, "Tender for Power Plant Equipment," will be received up to 5 p.m. on Saturday, December 6th, 1919. Plans and specifications may be obtained on application to M. D. Cadwell, Superintendent of Utilities, City Hall, North Battleford, Sask.

Winnipeg, Man.—Time for receipt of tenders for manufacture, delivery and erection in city's power-house at Point du Bois of two units of horizontal shaft turbines for direct connection to alternating current generators and governors for controlling same has been extended to 3 o'clock p.m., Monday, December 1st. C. J. Brown, city clerk.

RAILWAYS

Bowmanville, Ont.—Ratepayers passed Hydro-radial by-law.

Guelph, Ont.—W. H. Breithaupt, president of the Waterloo and Wellington Ry., of Kitchener, submitted to Mayor Carter a proposal to connect Guelph and Kitchener with a line that would run through Bridgeport, Bloomingdale, New Germany and Marden, a distance of 15½ miles. There would also be a bridge over the Grand river. Estimated cost, $280,000.

Halifax, N.S.—According to a statement made by Grant Hall, vice-president of the C.P.R., who recently made a tour of inspection over the Dominion Atlantic Ry., in company with General Manager George Graham, before long the present light rails on the D.A.R. will be replaced by heavier standard steel.

Hamilton, Ont.—Board of Control recommended to city council that by-laws for $607,173 for the construction of the local end of the Guelph-Galt-Hamilton Hydro radial line be submitted to the electors in January. A resolution was also passed, urging Sir Adam Beck to start construction on the lines which have been authorized.

Hamilton, Ont.—Plans of the proposed Hydro radial line from Guelph and Elmira to this city have been filed with the city clerk. The cost is estimated at $6,530,000. The plans provide for a terminal for all radial lines on James St.

Oshawa, Ont.—Ratepayers passed Hydro-radial by-law.

Quebec, Que.—Dominion government will shortly take over the Quebec and Saguenay Ry.

Scarboro Tp., Ont.—Electors passed Hydro-radial by-law.

Toronto, Ont.—Ontario Railway and Municipal Board have given a decision overruling the objections raised by the Toronto and York radial railway to the city of Toronto constructing the Mount Pleasant railway line. The plans for the latter were also approved by the board's engineer.

FACTORIES AND LARGE BUILDINGS

Bedford, N.S.—The sawmill and box factory owned and operated by Moirs, Limited, was destroyed by fire recently. Building was insured for $50,000.

Belleville, Ont.—The Judge Jones Milling Co. is constructing a large elevator here.

Brantford, Ont.—Brantford Golf and Country Club plan enlargement of clubhouse.

Brantford, Ont.—Plans are being prepared for two wing extensions to the Collegiate Institute.

20-Year Barrett Specification Roof on Foundry Bldg. of Thos. Davidson Mfg. Co., Ltd., Montreal. Can. Arch.: A. W. Robinson, Montreal; Gen. Con.: A. F. Byers & Co., Montreal; Roofers: Hickey & Aubut, Montreal.

A 20-Year Guaranty Roof protects this Canadian Foundry—

A foundry roof has more than weather to withstand. It must be able to resist the intense heat of the furnaces underneath, and showers of red-hot sparks from above.

When the roof on the foundry building shown above was completed we gave the owners a Surety Bond *guaranteeing* their roof to be free from maintenance expense for *20 years*.

In this case the Surety Bond was hardly necessary, for the Thos. Davidson Mfg. Company, Ltd knew from experience what service to expect, as the following paragraph from their letter to us shows:

> "You will no doubt be interested to know we have insisted on Barrett Specification Roofs on all our plants, as our experience has proved it to be in every way satisfactory."

Not only are Barrett Specification Roofs "in every way satisfactory," but they cost less per-year-of-service than any other type of permanent roof, and they take the base rate of fire insurance.

20-Year Guaranty

So sure are we of the service Barrett Specification Roofs will give *under the most severe conditions*, that we are prepared to *guarantee them for 20 years*, in all towns of 25,000 or over, and in smaller places where our Inspection Service is available provided they are 50 squares or more in area. The guaranty costs you nothing. We merely require that our Specification dated May 1, 1916, shall be strictly followed and that we have an opportunity to send inspectors to watch the job during construction. The guaranty is a Surety Bond issued by a well-known fidelity and guaranty company.

Copies of The Barrett Specification, with roofing diagrams, mailed free on request.

The Barrett Company LIMITED

MONTREAL TORONTO WINNIPEG VANCOUVER
ST. JOHN, N.B. HALIFAX, N.S. SYDNEY, N.S.

Brantford, Ont.—Ratepayers will vote on erection of following:—An addition to the Brant Sanatorium, new isolation hospital, extension to the General Hospital, and two additional wings to the Collegiate Institute.

Calgary, Alta.—An annex will be built to the General Hospital. Address, R. J. Crichton.

Calgary, Alta.—Order-in-council has been passed by Dominion government, authorizing loan of $120,000 to the city for the purpose of erecting an annex to the General Hospital.

Calgary, Alta.—Plans will be prepared at once by provincial government for an Institute of Technology to be erected here. Minister of Education, Hon. Geo. P. Smith, Edmonton.

Campbellton, N.B.—The Rosebury Street School was damaged by fire to the extent of $25,000.

Charleswood, Man.—The municipal council will submit to the ratepayers a by-law providing for the borrowing from the Provincial government of $50,000 to be used for the building of houses. Clerk, Alex. B. Blakely.

Creelman, Sask.—Steps are being taken for the establishment of a union hospital here. Secretary-treasurer, C. W. Williams.

Edmonton, Alta.—Beatty Bros., Ltd., of Fergus, Ont., will erect a $200,000 warehouse on the corner of 109th St. and 103rd Ave. Additional western branches will be opened in Vancouver and Regina early next year. President, George Beatty.

Edmonton, Alta.—General contract for erection of city's main telephone exchange has been let to J. Dunlop for $80,468; the plumbing and heating contract to Lockerbie and Hole for $12,723, and the electrical work to Bert L. Perry, Ltd., for $2,546, all of this city.

Edmonton, Alta.—A delegation from the municipalities of Alberta convention asked Premier Stewart that steps be taken to secure Alberta's share of the $25,000,000, which the Dominion government has set aside for the provincial housing scheme, and to make it available for the purpose intended. Alberta's share on the population basis was placed at $1,500,000. The premier expressed his willingness to take the matter up, but said that a provincial scheme might be devised that would be even better for the local situation than that offered by the Dominion.

Edmundston, N.B.—Fraser Companies, Ltd., plan erection of a large saw mill near Edmundston.

Galt, Ont.—Work has started on a 142 by 32 ft. extension to the machine shop, and 44 by 26 ft. addition to the moulding shop of the Perfect Machinery Co. Brick construction.

Glace Bay, N.S.—The Y.M.C.A. will erect a new building. Secretary, Capt. Watt.

Glace Bay, N.S.—The School Board rejected all tenders received for the new central school building. The board will now supply all material and work will be in charge of Frank McSween. Tenders for excavating have been called.

Halifax, N.S.—The Crane Company, an American hardware concern, proposes to erect a large building here.

Hamilton, Ont.—Damage to the amount of about $60,000 was done recently by fire and water to the John Lennox building here.

Hamilton, Ont.—A million-dollar company which proposes to erect a large Pantages theatre, has been organized and will seek incorporation at once. Address George Stroud, manager, Savoy Theatre, Hamilton.

Hamilton, Ont.—Excavating contract let to A.Cope & Son in connection with erection of first unit of Firestone Tire and Rubber Company's plant. Designs for building not completed yet, and contracts for same not let. Manager, O. W. Cook.

Hamilton, Ont.—Permits have been issued to W. H. Cooper for a brick factory for the Canadian Carbonate Co., on Simcoe St. W., at a cost of $10,000, and to W. H. Yates for an addition to plant for the Bell Thread Co., Huron St., $15,000.

Hamilton, Ont.—F. Guest, head of the company owning and operating the Strand, Empire and Queen's theatres in this city, has purchased a site for a large combination building to consist of a motion-picture theatre, stores and private apartments.

Harriston, Ont.—A by-law authorizing the erection of a memorial hall may be submitted to ratepayers at next election.

Lethbridge, Alta.—At a representative gathering here the necessity of a Normal school for the southern portion of the province was urged on the government.

London, Ont.—At the January elections the ratepayers will vote on a by-law authorizing the erection of a $100,000 memorial hall.

London, Ont.—Building permit issued to the McClary Mfg. Co., for erection of a three-story shop building, 61 by 183 ft., on Adelaide St. Estimated cost, $55,600.

Mallorytown, Ont.—Plans for the erection of a consolidated school have been drawn by Benjamin Dillon, architect, Brockville, Ont.

Montreal, Que.—A public hall is to be erected at once in the rear of the station at Springfield Park. Address Major G. P. Vanier.

Montreal, Que.—A new church, to be known as "Trinity Memorial Church," will be erected in Notre Dame de Grace. Rector, Col. the Rev. Canon J. M. Almond.

Montreal, Que.—The necessity for the immediate extension of Peel Street club house is being urged by President W. R. Grainger, of the Montreal Amateur Athletic Association.

Montreal, Que.—The main building of the University of Montreal, better known as Laval University, was destroyed by fire on November 22nd. The damage is estimated at $400,000.

Montreal, Que.—A private bill will be introduced at the forthcoming session of the legislature for incorporation of a new hospital under the name of St. Mary's Memorial Hospital. Those asking incorporation are Lord Shaughnessy, Hon. C. J. Doherty and Dr. Francis Devlin.

Oshawa, Ont.—The Chamber of Commerce and Women's Institute are considering the advisability of building a community hall.

Parry Sound, Ont.—Town council may erect an aerodrome.

Pembroke, Ont.—The Pembroke Cottage Hospital Association plans erection of addition to hospital. President, Andrew Johnston.

Pitt Meadows, B.C.—Council will erect a recreation hall at a cost of $1,500. Councillor, R. H. Sharpe.

Port Arthur, Ont.—Board of Education is seeking a site for a new collegiate institute. Chairman, Mr. Young.

Port Haney, B.C.—A new three-room school is planned at a cost of about $15,000. Trustee, Mr. Platt.

Port Moody, B.C.—The British Columbia Refinery Co. is building a new boiler-house. Contractor, J. C. McRae.

Quebec, Que.—The factory of J. A. Scott, St. Valier St., is to be repaired. Cost $1,100.

Quebec, Que.—A large sawmill belonging to the Jackman Lumber Company was entirely destroyed by fire. Loss, $125,000.

Quebec Que.—A three-story brick building will be erected at the corner of St. Roch and des Fosses Sts. Address Fitch, Phillips, Ltd.

Regina, Sask.—Permit has been granted for the new community hall for the Imperial Oil Company. The building will be two stories, 91 by 66 feet, and will cost $17,000. Frame construction.

Renfrew, Ont.—The construction of a sawmill of reinforced concrete has been started by Gillies Bros., Ltd. All of the machinery is to be electrically-driven. A. F. Byers & Co., engineers and contractors, of Montreal, have the work in hand.

BURLINGTON
STEEL CO LTD
HAMILTON
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S
STEEL
BARS
FOR CONCRETE
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LTD
ROUNDS SQUARES FLATS CHANNELS ANGLES
TWISTED SQUARES SPECIAL SECTIONS
BARS BENT TO SHAPE FOR BEAMS, STIRRUPS, ETC.
PROMPT SHIPMENT

St. Thomas, Ont.—A campaign for the advancement of the proposed memorial hospital for St. Thomas and Elgin County is being launched. Chairman of Special Committee, Dr. J. D. Curtis.

St. Thomas, Ont.—General contract let to A. E. Ponsford, Ltd., St. Thomas, for erection of new building for Molsons Bank.

Sarnia, Ont.—McGibbons Limited will enlarge their lumber building.

Sarnia, Ont.—The Holmes Foundry Co., Ltd., have let the contract for a 200-ft. addition to their present foundry building.

Saskatoon, Sask.—Building operations on the new $35,000 rink will begin at once. Architect, David Webster.

Sherbrooke, Que.—Sherbrooke Housing Company has purchased a property for the erection of a model city, on which a hundred houses will be built to accommodate the employees of the new Canadian Connecticut Cotton plant here.

South Devon, N.B.—The Nashwaak Pulp and Paper Co. has purchased a new pulp and paper mills site here. The company now has under construction on the Nashwaak River at Marysville a large concrete dam from which, it is understood, electric power will be developed for the proposed mill at South Devon.

Sudbury, Ont.—Fire damaged the high school to the extent of several thousand dollars.

Sydney, N.S.—E. Le Roi Willis is considering the formation of a company with the object of erecting a hotel in Sydney.

Timiskaming, Que.—It is rumored that contract No. 3 in connection with the construction of the Kipawa Fibre Co.'s new paper mill here has been awarded to the G. A. Fuller Construction Co. This contract is said to cover the extension of all the buildings constructed, and it is reported that it amounts to about $3,000 000 additional work.

Toronto, Ont.—Canadian General Fire Extinguisher Co., Chelsea Ave., propose to erect a large plant.

Toronto, Ont.—T. Kinnear & Co., 49 Front St. E., will erect a $150,000 warehouse on Dupont Street.

Toronto, Ont.—"King Fashion" Tailors, 101 Yonge St., will erect a 6-story building at 93-99 Bathurst St.

Toronto, Ont.—Tender of Lewis Le Grow for drain work at Kitchener School, $2,747, accepted by Board of Education.

Toronto, Ont.—City council adopted recommendation for erection of $20,000 fire station in Ashbridge's Bay industrial district.

Toronto, Ont.—A two-story moving picture theatre will shortly be erected on Danforth Ave., north side, east of Greenwood.

Toronto, Ont.—Willard's Chocolates, Ltd., will erect a large new building at the northeast corner of Dupont St. and Manning Ave.

Toronto, Ont.—Plans for two additional wings to Earl Grey School, Jones Ave., have been approved, and work will commence shortly.

Toronto, Ont.—City council passed the recommendation that the people be asked to vote $1,000,000 for a live stock arena, to be erected at the Exhibition grounds.

Toronto, Ont.—The harbor commission will hold a conference with Col. Barker, V.C., regarding the establishment of a municipal airdrome and a suitable site for same.

Toronto, Ont.—The Orange Society is endeavoring to raise $300,000 for the erection on Yonge St., near Richmond Hill, of Royal True Blue and Orange Home for Orphans.

Toronto, Ont.—City council granted permission to Dr. D. Campbell Meyers to alter the interior of his neurological hospital at 72 Heath St. W., so as to convert it into an apartment house.

Toronto, Ont.—The following permits have been issued: E. L. Ruddy Co., studio building, two-story brick, 315-25 Spadina Ave., $25,000; A. D. Waste and R. H. Bishop, two-story brick office building, 929-31 West Bloor St., $16,000.

Toronto, Ont.—The tenders for the new Salvation Army building on Dufferin St. have proven to be much higher than was expected and the plans will be considerably modified. It was estimated that the sum of $25,000 would be sufficient, but the lowest tender was $28,000.

Toronto, Ont.—Board of Education let following contracts in connection with erection of an addition to Parkdale Collegiate Institute: Asphalt mastic to Construction Steel Supply Co., Ltd., at $2,526.25, and for ornamental iron work to the Canadian Ornamental Iron Co., Ltd. New tenders will be called for plastering.

Toronto, Ont.—The following building permits have been granted:—H. Burnside, garage, Danforth Ave., near Ashdale Ave., $15,000; Globe Printing Co., addition to printing office, 60 Yonge St., $35,000; Secord and Howie, garage, 2811 Dundas St. West, $17,500; Jefferson Glass Co., factory, 388 Carlaw Ave, $55,900.

Valois, Que.—The Citizens' Association is making arrangements for the erection of a memorial hall.

Vancouver, B.C.—Plans of Sharpe and Thompson for proposed natatorium and amusement hall at English Bay were submitted to the parks board.

Vancouver, B.C.—The B.C. Fir and Cedar Lumber Co. will reconstruct its plant which was recently destroyed by fire.

Vancouver, B.C.—Two new branches of the Royal Bank of Canada will shortly be established in this city. In addition to this, one of the present branches will be extended to approximately double its present size.

Vancouver, B.C.—There will be an expenditure of $600,000 made by the Imperial Oil Co. for the plant at Ioco, on Burrard Inlet. The extensions include additions to the treating plants, acid restoring plants, and refinery.

Vancouver, B.C.—Permits granted to the Independent Van and Storage Company, 410 Nelson Street, for erection of garage at a cost of $2,000; and to the Dominion Construction Company, Granville Island, for warehouse to cost $3,500.

Victoria, B.C.—Tenders will be received at the office of T. H. White, chief engineer, C.N.P. Rly., Vancouver, B.C., until 12 o'clock noon, November 29th, 1919, for the supply of all labor and materials for the erection of: Five-stall engine house and machine shop and turntable foundation at Songhees Reserve, Victoria, B.C. Plans and specifications may be obtained at the office of the District Engineer, Victoria, B.C.

Walkerton, Ont.—Cloe Clark has decided to build a one-story theatre. Estimated cost, $5,000.

Walkerville, Ont.—Representatives of Walkerville and Ford G.W.V.A. and Walkerville town council will confer on the request of the returned men for a grant of $40,000 toward a war memorial hall.

Whitby, Ont.—Ratepayers passed by-law to spend $60,000 on new school buildings. Clerk, Joseph White.

White Rock, B.C.—A movement is on foot for erection of a memorial club house.

Windsor, Ont.—Cross & Co., manufacturers of contractors' and builders' supplies, plan additions to their factory next spring.

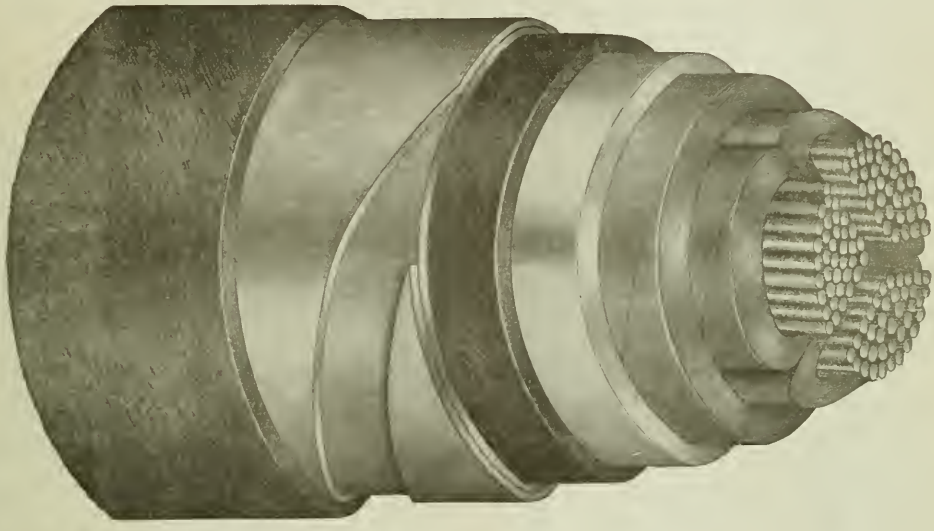
Winnipeg, Man.—Marcus Loew will build a $600,000 theatre in Donald St., construction to start in March. Architect, T. W. Lamb, 263 Yonge St., Toronto.

Winnipeg, Man.—E. H. Rodgers, building inspector, estimates that building permits next year will total $10,000,000. This year the permits will run close to $3,000,000. The total for 1918 was $2,000,000.

MISCELLANEOUS

Agassiz and Rosedale, B.C.—Tenders will be received by the Honorable the Minister of Public Works up to noon of Wednesday, December 3rd, 1919, for the erection and completion of ferry landings near Agassiz and Rosedale, B.C., on the Fraser River. Plans and specifications may be seen at the Department of Public Works, Parliament Buildings, Victoria, B.C., and at the office of the District Engineer, Van-

PAPER INSULATED CABLES



The above is a full-size illustration of a 350,000 C.M. 3-conductor 12,000 volt Paper-insulated Lead-covered Steel Tape Armoured Cable. Overall diameter 3.62 inches. Manufactured by us to the Specifications of the Hydro-Electric Power Commission of Ontario.

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couver, B.C. A. E. Foreman, public works engineer, Public Works Department, Victoria, B.C.

Bamfield and Ucluelet, B.C.—Tenders, addressed to R. C. Desrochers, secretary, Department of Public Works, Ottawa, will be received until 12 o'clock noon, Monday, December 22nd, 1919, for repairs to wharves at Bamfield and Ucluelet, Comox-Atlin District, B.C. Plans can be seen and specification obtained at the Department of Public Works, Ottawa; at the offices of the District Engineer, Victoria, B.C., and at the post-offices, Bamfield and Ucluelet, B.C.

Brandon, Man.—Public Utilities Commission will take up the question of constructing a dam in Assiniboine River.

Bridgeburg, Ont.—The Reliance Manufacturing Co. has just been incorporated with a capitalization of half a million dollars. The concern will be located on Lewis St., and will manufacture electrical goods.

Glace Bay, N.S.—Repairs to the breakwater will be undertaken at once by the Department of Public Works, Ottawa. Estimated cost, $6,000. Engineer, Mr. Coultee.

Halifax, N.S.—The Canadian Incinerator and Furnace Co., Ltd., Toronto, have just completed the installation of three oil-burning furnaces for the Halifax shipyard. The same firm previously installed at the same yard two large furnaces which are being continuously used in bending frames and plates for the four new ships now under construction here.

Oshawa, Ont.—Town council authorized the construction of certain concrete sidewalks, water mains and sanitary sewers. Town engineer, G. W. Worden.

Ottawa, Ont.—Joint stock companies incorporated last week include the following: Baldwin Canadian Steel Corporation, Ltd., capital, $500,000, Toronto; National Steel Car Corporation, Ltd., capital, $500,000, Toronto; Elliot Machinery Co., Ltd., capital, $250,000, Belleville Ont.

Owen Sound, Ont.—Tenders, addressed to R. C. Desrochers, secretary, Department of Public Works, Ottawa, will be received until 12 o'clock noon, Friday, December 12th, 1919, for the reconstruction of a wharf at Owen Sound, Ont. Plans can be seen and specification obtained at the Department of Public Works, Ottawa; at the office of the District Engineer, Equity Building, Toronto, Ont., and at the Post Office, Owen Sound, Ont.

St. John, N.B.—Tenders, addressed to R. C. Desrochers, secretary, Department of Public Works, Ottawa, will be received until 12 o'clock noon, Tuesday, December 9th, 1919, for the construction of grain conveyor equipment, at Berth 15, St. John Harbor, N.B. Plans can be seen and specifications obtained at the Department of Public Works, Ottawa; at the offices of the Engineer-in-charge, St. John, N.B.; the District Engineers, Shaughnessy Building, Montreal, Que., and Equity Building, Toronto, Ont.

Sorel, Que.—Dominion Department of Public Works let contract for reconstruction of wharf to Onesime Poliquin, Portneuf, Que.

Sydney, N.S.—Dominion government will erect a new terminal wharf here at a cost of $100,000.

Vancouver, B.C.—Five new steel ships of 9,500 tons each will be constructed at the G. M. Standifer Shipbuilding Co. yards during the next six months.

Vancouver, B.C.—It is rumored that the Dominion government is contemplating the purchase of the Hastings Mill site for harbor development purposes.

Vancouver, B.C.—The Great Northern Railway Co. are planning an addition of about 500 ft. to their present docks in this city. Assistant traffic manager, M. J. Costello.

Victoria, B.C.—Certificates of incorporation have been granted to the following new companies:—Marsh-Bourne Construction Co., Ltd., Vancouver, capital, $250,000; Maddison Salvage Corporation, Ltd., Vancouver, capital, $10,000.

Winnipeg, Man.—The establishment of a wireless telephone system throughout the settlements in northern Manitoba, at an estimated cost of from $25,000 to $30,000, will be recommended to the provincial government by Prof. R. G. Wallace, commissioner for this territory.

Tenders Called For

CITY OF NORTH BATTLEFORD, SASK.

TENDERS FOR POWER PLANT EQUIPMENT

Sealed tenders, addressed to the undersigned, and marked, "Tender for Power Plant Equipment," will be received up to 5 p.m. on Saturday, December 6th, 1919, for two 250-h.p. Water Tube Steam Boilers, one Sheet Metal Stack, 50" x 60', and a quantity of Metal Smoke Flue.

Plans, specifications and all further information may be obtained on application to M. D. Cadwell, Superintendent of Utilities, City Hall, North Battleford, Sask.

ROBERT FARQUHARSON, City Clerk.
The City Hall, North Battleford, Sask.,
November 18th, 1919. 383

CITY OF SASKATOON

SALE OF 750 K.W. GENERATOR SET

The City of Saskatoon invites offers for the purchase of the following electrical machinery:—

One 26" x 48" x 30" Roll Armstrong Vertical Cross-compound Engine, direct-connected to 750 k.w. General Electric two-phase, 2,300-volt, 60-cycle Generator, complete, with surface condenser, air-pump, etc.

This unit is being offered for sale in order to provide room for a larger set, is in first-class running condition, and can be shown in operation at the City Power Plant.

Tenders to be delivered to the undersigned on or before 12 noon on Friday, the 12th day of December, 1919.

C. J. YORATH,
382 City Commissioner.

HYDRO-ELECTRIC POWER COMMISSION OF ONTARIO

RAILWAY DEPARTMENT

SUPERSTRUCTURE OF HIGHWAY BRIDGE ACROSS WELLAND RIVER AT CHIPPAWA, ONTARIO

ADVERTISEMENT FOR TENDERS

Sealed tenders will be received until November 28th, 1919, at 12 o'clock noon, addressed to Sir Adam Beck, Chairman, Hydro-Electric Power Commission of Ontario, 190 University Avenue, Toronto, Ontario, and marked "Tender for Chippawa Highway Bridge." Plans, specifications, and other information may be obtained by applying to the office of Chief Engineer. The Commission reserves the right to reject any or all tenders received.

Hydro-Electric Power Commission of Ontario.

W. W. POPE,
Secretary.

Dated at Toronto, November 14th, 1919.

The time for acceptance of the above tenders has been extended to 12 o'clock noon, December 6th, 1919.

Hydro-Electric Power Commission of Ontario.

W. W. POPE,
Secretary.

Dated at Toronto, November 24th, 1919. 375

A new company known as the Trading Engineers, Inc., has been formed by a number of South American, United States and Canadian engineers.

The Canadian Engineer

A Weekly Paper for Civil Engineers and Contractors

Report Presented by Status Committee to J.C.T.O.

Complete Text of Draft Bills Formulated for Joint Committee of Technical Organizations by Its Status Committee (H. G. Acres, Chairman) as Model Legislation for Uniform Provincial Acts — Report of Status Committee, Introductory to Draft Bills, Discussing Need for Legislation

THE phrase, "Status of the Engineer," may be roughly defined as the reputation and degree of prestige which the engineer enjoys or deserves in the eyes of his fellow-citizens, having due regard to the value of his services to the public at large.

Status involves two essential factors: First, recognition of engineering as an essential profession, through the agency of both public sentiment and legal enactment; and, second, an adequate scale of remuneration for services, as compared with other professions and with trades.

These two factors may be shortly defined as "recognition" and "remuneration."

In handling the above two phases of this problem it is necessary to determine whether they are of equal importance, or whether one takes precedence over the other, and, finally, if the latter is the case, to fix the order of precedence.

The argument under this head can be conveniently established by analogy. From the bald standpoint of remuneration, engineering service is just as properly a commodity as manual labor, and the revenue derived from its sale is governed first by the number of purchasers who need it, or think they need it, and second, by the amount of such commodity the individual purchaser can be prevailed upon to absorb in place of some other commodity which he has used previously in place of it. There is no virgin market for engineering services. It must compete in long-established markets with other commodities which it must supplement or displace.

The organization of the trade union was essentially an expedient to advertise the worth and importance of a commodity which, for lack of a better term, may be called "manual labor." The unity of interest created by such organizations enabled the manual worker to make use of the strike as an additional advertising expedient, and as a result of the forced recognition thereby realized, he was able to demand a higher price for the commodity he produced, and by the sale of which he existed.

Commodity Must Be Recognized

There was no virgin market for shredded wheat. A carefully planned and extensive advertising campaign was instituted to prevail upon the public to eat shredded wheat instead of oatmeal porridge. Through this expedient recognition of shredded wheat was grafted on the public mind. It was educated to think it needed shredded wheat, and thereafter remuneration accrued to the Shredded Wheat Co., with resulting prosperity.

Whether the commodity is "manual labor" or whether it is "shredded wheat," it must be recognized before it can be sold. The greater the public need, whether fundamental, as in the case of manual labor, or cultivated, as in the case of shredded wheat, the greater and more certain will be the remuneration.

Considered from the non-æsthetic standpoint as a commodity, engineering service must conform to the same economic laws, and recognition must of necessity be the precursor of remuneration. This proposition would seem to be amply vindicated by the fact that it applies to any individual consultant who has a large clientele, and who can demand a large fee for his services. Almost invariably it will be found that such a man has demanded a higher price for his services as their value became more fully recognized and established. He first obtained recognition through the medium of some form of advertising, which educated an ever-increasing body of the public to need him, or think they needed him, and remuneration followed as a matter of course.

Recognition Precedes Remuneration

The problem of establishing the status of the engineer therefore resolves itself essentially into devising some means of applying to engineers as a class the laws which have operated successfully in the case of the engineer as an individual. In other words, engineering service generally must have recognition commensurate with its value to the community at large before adequate remuneration can be obtained for engineers as a class.

If, therefore, the engineer is to take the place in the community to which he is entitled by virtue of his attainments and the high class of service he can render, the primary requirement is recognition.

Recognition is obtainable by two general methods, more or less distinct—namely, by general publicity and by legislation.

The ordinary means of obtaining publicity for the engineering profession are many and diverse. The outstanding requirement under this head is for engineers as a class to participate in the affairs of national and provincial government. This contention is so fundamentally sound and has been so often repeated, and so generally recognized, that it is not necessary to enlarge upon it. It is true beyond the possibility of argument that the status of the engineer as related to national affairs cannot be advanced or conserved unless engineers themselves exercise active governmental functions, and pass, as well as frame, the laws relating to or incidentally affecting the profession. The civil service bill now before the Dominion house is a luminous exemplification of this condition. This bill is of vital importance as related to the status of engineers as a class. It seeks to give engineers in the civil service a professional status as distinguished from the status of the ordinary departmental clerk, and also to establish an advanced salary scale. It has been framed with the assistance of engineers, but it is fairly safe to say that there is not a single practising engineer in the House of Commons to argue and support the passing of this bill. Its very doubtful fate rests mainly in the hands

of lawyers, doctors and farmers. The probable opposition and non-support of such men cannot be charged so much to active enmity as to excusable ignorance and lack of interest, for which condition engineers themselves are mainly responsible.

Among other channels of publicity may be mentioned the active participation of engineers in town planning, housing and settlement problems, and in developing such problems into specific schemes for government ratification and administration. Conditions governing publicity in the broad sense demand that engineers must seek out and identify themselves with all beneficent movements and projects, particularly those which have a wide public appeal.

Unionism Not Proper Medium

Finally, there comes the question of unionism as a means of obtaining recognition through publicity. The various technical organizations of this country could assume the essential functions of a trade union if their constitutions were so amended as to permit them to adopt the principle of collective bargaining and to promulgate strikes. This method of obtaining recognition is without doubt repugnant to the majority of engineers, and, while some transitory benefit might be derived by junior engineers, the general effect would be a very material lowering of the status of the engineer in his own estimation, and in the estimation of the public from whom he derives sustenance. It is difficult to conceive of a town manager, a commissioner of works or a consulting engineer participating in a strike, or to imagine that the diverse, and at the same time interlocking, activities of engineers could be so grouped and segregated as to render them susceptible to the principle of collective bargaining. The proper sphere of activity for any man who wishes to use collective bargaining and the strike as an economic weapon is in a trade, and not in a profession. The value of creative engineering work and the work incidental to the solution of engineering problems in general must be appraised on an individualistic and not on a collective basis. Unionism does not therefore appear to be a proper medium of publicity for engineers to employ as a means of obtaining recognition.

The other factor involved in the problem of recognition is legislation. In its relation to the matter of recognition, legislation should be considered as a defensive weapon, as distinguished from publicity, an offensive weapon. In other words, publicity should be the sword, and legislation the shield, of the engineering profession.

Legislation For Public Welfare

The primary function of all legislation is the protection of the public. If this principle is rigidly applied to any engineering legislation that may be framed, it will be found that the engineer has received his full measure of protection, not as an engineer, but as a part of the body politic. All that engineers as a class are entitled to is some effective means of protecting their professional reputation and prestige. Legislation can certainly be framed to meet this end, and so framed as to be for, and not at the expense of, the public weal.

Anything beyond this must be defined as "class legislation," which, in the final analysis, does not protect, but stigmatizes, and would ultimately force the engineer into the position of having to protect his legislation instead of having his legislation protect him.

On the basis of the above premises, therefore, it should be possible to roughly outline the salient features which properly framed engineering legislation should embrace.

The more important features of such legislation are cited hereunder.

Cognizance of Existing and Future Conditions.—Under this head must be considered the comparative youth of engineering as a recognized profession, and the very great difficulty of so exactly defining the functions and activities of an engineer that such definition would hold in law. It would appear that the most practicable way of overcoming this difficulty would be to vest considerable discretionary power in any board or commission which might be delegated to administer the law. This discretionary power would be exercised in respect of such matters as the recognition of engineers practising at the time the law comes into effect, the classification of engineers according to specialties, the formation of partnerships, the granting of exemptions, the fixing from time to time of standards of qualification, the revocation of privileges, and the enforcement of penalties.

Malpractice.—The public and the competent engineer should be protected from wilful or involuntary malpractice. It is just as important to have healthy and efficient engineering structures built by responsible and competent engineers as it is to have the health and efficiency of the individual citizen maintained by competent medical supervision. If the protection of the law is necessary in one case in the public interest, it is equally necessary in the other.

Conservation of Man-Power.—The necessity for conserving and developing national resources to the utmost is receiving world-wide recognition at the present time. The development and conservation of natural resources can reach a high stage of efficiency and economy only by giving primary consideration to the conservation and development of man-power. The man-power of the province of Ontario is developed in one direction by an elaborate system of public education, consisting of primary schools, high schools, collegiate institutes and a government-supported university. The province, therefore, expends a considerable sum of money on every engineer it graduates from the university, but under present conditions ceases thereafter to assume any responsibility for his professional advancement or to provide for any return on the investment made in his behalf. Obviously, this return could best be realized by applying the engineering man-power so created to the development of provincial industry and to the conservation and development of the natural resources of the province. Such procedure would be eminently in the public interest, and any enactment leading to its consummation would come well within the limits of permissible engineering legislation.

Development of Home Trade.—This phase of the situation is closely allied to the problem of conserving man-power.

The surest indication of a country's prosperity is a favorable trade balance, which in turn is measured by the volume and extent of its home trade. The condition of the home trade of any country is solely dependent upon the volume and diversity of the commodities it can produce for the needs of its own citizens. This condition applies as properly to the service of its engineers as to the products of its fields, and any measures taken to provide that engineering service be purchased within the province would be in the public interest in so far as the development of home trade is concerned.

International and Interprovincial Comity.—Under this head comes the important feature of so framing engineering legislation as to obviate any onerous restrictions on the practice of the profession by bona fide engineers entering the province temporarily, or with the intention of becoming permanent or naturalized citizens, and in general to place the engineering profession in the province beyond the fear of reprisals, or other demonstrations of ill-feeling, on the part of other countries or provinces. This feature is more or less in direct opposition to any drastic enactments which might be considered in relation to the conservation of man-power and the development of home trade. These three features must, therefore, be considered together in an effort to effect a reasonable compromise.

Assuming the above general specifications as a ground work for the framing of a law which, while adequately establishing and protecting the status of the engineer, will at the same time be in the public interest, it remains to discuss the general form in which such legislation might be presented.

All existing and proposed legislation of this class involves the principle of registration, and the issue, in some form or other, of a license to practise. It is significant that all engineering legislation recently enacted vests the administrative control of registration and the issue of licenses in the government, and not in a council or board appointed by the engineers themselves. Herein lies the basic distinctio

between "class" legislation and "popular" legislation, as applied to the particular subject under discussion.

The most comprehensive piece of legislation now in force with reference to this subject is that incorporated in the Civil Administrative Code of the State of Illinois. In this case the administrative function is vested in a department of registration and education, and the powers of this department are made sufficiently broad and general to permit it to exercise its functions not only in respect of all professions, but all trades. The regulation of any specific profession or trade is accomplished in two ways—either by a special act making regulation compulsory, or by application to the department of registration, voluntarily requesting regulation. Two instances of the first alternative are the structural engineers and the architects of Illinois, in respect of both of whom compulsory regulating acts were introduced in the state legislature during the present year.

Two pieces of legislation, the first covering the general principle, and the second the specific case, constitute what appears to be an adequate and satisfactory means of improving and fixing the status of the engineering profession in Illinois, while at the same time they express the popular will.

The latest development in legislation of this class is the Michigan Registration Act. In this act an effort is made to devise workable legislation covering the combined activities of engineers, architects and surveyors. While it lacks the complete generality of the dual enactments of the State of Illinois, it similarly vests administrative control in the government, thus classing the act as popular legislation, and it furthermore avoids the dangerous practice of attempting to rigidly define by legal enactment the professional functions and activities of engineers, architects and surveyors. Instead, it leaves all matters relating to the classification and status of applicants for registration to a registration board which is created under the terms of the act. While the exercise of this discretionary power may possibly lead to anomalies and abuses, it will be much easier to remove them by subsequent amendments to the act than to revise, extend or condense, by amendment, the legalized definition of a civil engineer, a mining engineer, an architect or a surveyor.

The likelihood of an engineering act becoming law is largely dependent on the generality and breadth of its application, and on the basis of this test the two Illinois acts have more of the aspect of popular legislation, and have a wider public appeal, than the single Michigan act. Consequently, while it might not be proper to frame a general registration act to cover trades as well as professions, it would seem advisable to consider the adoption of the Illinois principle in so far as engineering and the allied professions are concerned. With legislation so limited for the time being, it could later be enlarged by amendment to include all professions and technical occupations, should it ever be necessary in the public interest to do so.

Based upon the above premises and specifications, it should now be possible to tentatively frame the terms of an act in sufficient detail to furnish ground for discussion.

TITLE: An Act to regulate the practice of professions and allied technical occupations and to provide for the registration of persons engaged in practising the same.

Short Title.—"The Professional Registration Act."

Administrative Agency.—The creation of a Department of Registration under the jurisdiction of the Minister of Education and the creation of the office of "Director of Registration."

Functions of Department of Registration.—(a) To administer and enforce laws relating to the regulation of specific professions and technical occupations, and to formulate rules and regulations for administering the same and for the fair and impartial examination of candidates for registration.

(b) To establish and control the standard of preliminary education necessary for admission to training schools, colleges and universities.

(c) To provide, on appeal, for re-examination of candidates and for rehearings in the case of action to revoke a license or certificate where it appears that justice has not been done.

Specific Legislation.—Specific legislation for the regulation of any particular profession, technical occupation or branch thereof may be introduced (a) on the initiative of the Minister of Education, should he consider such procedure necessary in the public interest; or (b) by request, through the Minister of Education, of a majority of the persons engaged in such profession, technical occupation or branch thereof.

Certificates and Licenses.—To be issued by the Department of Registration.

Exemptions.—The provisions of this act shall not be enforceable in respect of the practice of law, medicine, dentistry and surveying, as long as the laws now regulating these professions and occupations continue in force.

Assuming that the above terms, properly elaborated, would meet the requirements of a general act, which, by virtue of its generality, would require a minimum of amendment in the future, the next step is to outline the terms which should be incorporated in such specific or subsidiary acts as might be required in the future to embrace all branches of engineering activity, having particularly in mind the fact that, as the status of the engineer improves and becomes more generally recognized, his various lines of professional activity will become more sharply defined and more uniformly susceptible of regulation. The most acceptable form for these subsidiary acts is one which will be of the same general type for all branches of engineering, so that they can be passed as parts of the general act, at any time, by order-in-council, on the authority of a house resolution.

It would be necessary for such an act to contain the following provisions:—

TITLE.—An Act to regulate the practice of.....
and to provide for the registration of.....

Short Title.—"The .....Registration Act."

Administrative Agency.—Under the general direction of and appointed by, the Department of Registration, a Board of Examiners, one of whom shall be a professor or associate professor of.....in the University of....., and four other members, who shall be.....of recognized standing, who have had not less than ten years of bona fide experience in the practice of....., and who have resided continuously in the Province of .....not less than five years

Functions of Board.—(a) To receive applications for registration, and, at their discretion, accept those which properly come under the classifications they are delegated to examine, and to reject or refer elsewhere such applications as do not; (b) conduct hearings on matters relating to the revocation of, or refusal to renew, licenses or certificates, and at their discretion to revoke or refuse to renew the same; (c) establish regulations and rules of procedure for the proper administration of the law; (d) examine into and fix if necessary the standard of personal qualifications of applicants.

Reciprocal Registration.—Provision must be made for registration of practitioners from foreign countries or other provinces.

Public Works.—Provision making it obligatory that construction and maintenance work on provincial and municipal works be handled by qualified registrants under this act, in so far as it applies.

Further necessary provisions of this act include professional qualifications necessary for registration, discipline and penalties, formation of partnerships, and exemptions.

All of the above provisions will be found assembled in the accompanying draft act. The ancillary act here submitted refers to structural engineers, it being understood that the idea is to provide for additional ancillary acts of the same general type, referring to architects, electrical engineers, etc., and included in the general act as Part One, Part Two, etc. It will be noted that a number of the clauses in this draft act have been taken bodily from the proposed professional act prepared by the special legislation committee of the Engineering Institute of Canada. While this

draft act is a model piece of legislation of its kind, it was not analyzed and discussed in this report because it is essentially class legislation; it is only susceptible of comparison as a whole with the draft act herewith submitted.

In conclusion, the members of the Status Committee wish to point out that the subject of this report has so many complex and intangible ramifications, and is so vulnerable as related to existing legislation and public sentiment, that they do not presume to impose their views on their professional colleagues as the last word in engineering legislation. Their best hope is that there may be sufficient of interest in this report to prompt the various organizations represented by the Joint Committee to combine their energies and thrash out the issue to a definite conclusion.

PROPOSED DRAFT

An act to regulate the practice of professions and allied technical occupations, and to provide for the registration of persons engaged in practising the same.

Part One

HIS MAJESTY, by and with the consent of the legislative assembly of the Province of , enacts as follows:—

1. This act may be cited as "The Professional Registration Act."

2. There is hereby created a Department of Registration, which shall be under the jurisdiction of the minister of education of the Province of , and which shall be presided over by an appointee of the said minister, who shall have the status of a deputy minister, and who shall be styled the "Director of Registration."

3. It shall be the duty of the minister under this act—

(a) To administer and enforce laws relating to the regulation of specific professions and technical occupations.

(b) To establish rules and regulations for the proper administering of such laws, and for the fair and impartial examination of candidates for registration.

(c) To establish and control the standards of preliminary education necessary for admission to training schools, colleges and universities.

(d) To provide, on appeal, for the re-examination of candidates, and for rehearings in the case of action being taken to revoke a license or certificate or impose a penalty, when it appears that full justice has not been done.

(e) In all matters relative to the interpretation and administration of this act or any ancillary act, to give due and proper consideration to the representations and advice of members of the respective professions and technical occupations or of accredited organizations therein.

4. Within thirty days after any ancillary act relating to the regulation of any specific profession goes into effect, the minister shall appoint a board of examiners consisting of not less than three and not more than five members, and shall designate the chairman thereof. Tenure of office shall be so regulated that there shall not be more than one regular appointment to the board in any one year. Should a vacancy occur for any reason other than the expiry of a regular term of office, the minister shall fill the vacancy for the unexpired term, but otherwise subject to the rules governing regular appointments.

5. Members of board of examiners shall not receive compensation for their services, but shall be reimbursed for travelling and other actual expenses arising out of the performance of their duties under this act, and also for clerical and other assistance.

6. Ancillary legislation for the regulation of any specific profession, technical occupation, or branch thereof, may be introduced (a) on the initiative of the minister of education, should he consider such procedure necessary in the public interest; or (b) by request, through the minister of education, of a majority of the persons engaged in the practice of such profession, technical occupation, or branch thereof.

All such legislation shall be of the same general form as the ancillary act included herein as Part Two.

7. Pending the ratification of the appropriate ancillary act by the legislative assembly, any profession, technical occupation or branch thereof may meantime be made subject to the terms of the Professional Registration Act at the request of the minister of education and by consent of the lieutenant-governor-in-council.

8. All certificates, licenses and other authorities shall be issued by the Department of Registration, over the signature of the director, and with the seal of the department attached.

9. The provisions of this act shall not be enforceable in respect of the practice of law, medicine, dentistry or surveying so long as the laws now regulating such professions and occupations continue in force, or otherwise than through the provisions of sub-section (b), section 6, of this act.

Part Two—Ancillary Act

An act to regulate the practice of structural engineering and to provide for the registration of structural engineers.

HIS MAJESTY, by and with the consent of the legislative assembly of the Province of , enacts as follows:—

1. This act shall be cited as "The Structural Engineers' Registration Act."

2. In this act, unless the context otherwise distinctly indicates:—

(a) The word "minister" shall mean the minister of education of the Province of .

(b) The word "department" shall mean the Department of Registration.

(c) The word "director" shall mean the director of the Department of Registration.

(d) The word "board" shall mean the board of examiners appointed under the provisions of the Professional Registration Act.

3. On and after the date upon which this act goes into effect it shall be unlawful for any person to practise, or attempt to practise, structural engineering in the Province of without a certificate of registration or license to practise under the title of registered structural engineer, as issued by the Department of Registration under the provisions of the Professional Registration Act.

4. The following persons and things are exempt from the terms of this act:—

(a) Draftsmen, students, clerks of work, superintendents and other assistants of registered structural engineers, not taking responsibility for their work other than to their immediate superiors.

(b) Superintendents of construction in the pay of the owner when acting under the immediate supervision of a registered structural engineer.

(c) Any person, mechanic or builder, when making plans or specifications for, or supervising the construction, enlargement or alteration of, any structure or building which is to be constructed by himself or his employees for his own use.

(d) Any corporation preparing plans and specifications, and constructing, erecting or building engineering, industrial or monumental structures under the supervision of the corporation, provided the chief executive officer of the corporation, or the officer who immediately supervises the preparation of the said plans and specifications, and the building of such structures, is a registered structural engineer.

(e) Any person employed in actual service in His Majesty's naval, military or aerial service.

5. For the purpose of this act the board of examiners shall consist of five members, one of whom shall be a professor or associate professor of structural engineering in the University of , and the other four members registered structural engineers in good standing, who have had not less than ten years' experience in their profession and who have resided continuously in the Province of not less than five years.

6. A person is qualified to receive a certificate of registration as a structural engineer, without examination:—

(a) Who can prove to the satisfaction of the board, within one year of making application for registration, that he is a resident of the Province of at the date of the passing of this act, and who is at that date, and has

been for not less than five years previously, practising as a structural engineer.

(b) Who may come to reside in the Province of , and who at such time is a duly registered structural engineer under any similar act in any other province of Canada; provided that he shall present credentials as to his good standing satisfactory to the board, together with an application for transfer of registry endorsed by the proper administrative officer of such other province.

(c) Who submits proof, satisfactory to the board, of qualifications possessed by virtue of experience, training, or examination by any other examining body of recognized standing.

7. Otherwise than as provided under section 6 of this act, all candidates for admission to registration must be at least twenty-three years of age, and must have been engaged for eight years in some branch or branches of structural engineering, and for at least six years of such term in the employ of one or more structural engineers of recognized standing; provided, that in the case of a graduate from a recognized engineering college, the full period of such service shall be reduced to six years, which period will include his term of instruction.

8. Candidates for admission to registration under the terms of section 7 of this act shall submit to an oral and written examination before the board on the theory and practice of engineering, specializing in one or more of the various branches if they so desire.

A candidate failing on examination may, after an interval of not less than one year, be re-examined if he so desires.

9. Examinations shall be held as often and at such places as the minister may direct, and the scope thereof and the methods of procedure shall be fixed by the board, subject to the approval of the minister.

10. Any person not residing in the Province of who is a registered structural engineer under a similar law of any other province of the Dominion of Canada, may obtain from the director a non-resident license to practise as a structural engineer in the Province of upon production of evidence of his registry in such other province, and upon payment of a fee, the amount of which shall be fixed by the board. In the event of such person being unable, by reason of emergency or neglect on the part of the director, or for any other good and sufficient reason, to obtain such license within three months of his making application therefor, he shall be entitled to practise as a structural engineer in the province for such period of three months without holding such license.

11. Any person who is employed as an engineer by a public service corporation, a private corporation, public utilities or government department, whose business is normally carried on in two or more of the provinces of Canada, and who is by reason of his employment required to practise as a structural engineer in other provinces than that of his residence, may so practise in the Province of without holding a non-resident license, or payment of a fee, providing such person can, on demand of the board, produce credentials satisfactory to the board, showing that he is a registered structural engineer under a similar law of some other province of Canada. It shall be the duty of such person to produce such credentials whenever so required by the board; provided, that any structural engineer who is a resident of some other province of Canada, in which there is no registration or similar law, may obtain a license to practise, subject to the discretion of the board.

12. Any person who is not a resident of Canada, but who is a member of any engineering or technical organization or society of standing recognized by the board, may obtain a license to act in an advisory or consultative capacity to, or with, a registered structural engineer; provided, that reciprocal privileges can be accorded to registrants under this act.

13. Structural engineers practising in the Province of who were accepted for active overseas service in the War of 1914-18, in the forces of Great Britain, or any of her allies, shall be entitled to registration under the terms of sub-section "a" of section 6 of this act.

14. In the case of two or more persons carrying on practice as structural engineers in co-partnership, only such members as are registered or licensed under this act shall individually assume the function of a structural engineer. One or more registered structural engineers may lawfully enter into partnership with one or more registered practitioners of any other class.

15. No registered structural engineer shall be barred, under any of the terms of this act, from applying for registration, and being registered, pursuant to the provisions of any other registration act which may now or hereafter be in force in the Province of .

16. The board shall appoint a secretary and adopt rules and regulations for its own organization, and for the examination and classification of candidates for registration, and the issue of certificates thereto, and for carrying out the provisions of this act, and may amend, modify and repeal such rules and regulations from time to time. Such rules and regulations and any amendments thereto shall be subject to the approval of the minister.

17. The board shall at its discretion determine whether the experience and qualifications of any applicant are such as to make him eligible for examination and registration as a structural engineer, and shall reject or refer elsewhere any application which, in its opinion, does not fall within this category.

18. All moneys and fees collected or received under this act shall be properly recorded and receipted for and deposited with the provincial treasurer, who shall keep the same in a separate fund to be drawn against only for the expenses of the board.

19. All moneys expended by the board shall be paid through the provincial treasurer on properly drawn vouchers, signed by the chairman and secretary of the board.

20. Persons desiring to obtain a certificate or license shall apply therefor to the director, in writing, upon blanks prepared and furnished by the department. Each application shall be accompanied by proof of the particular qualifications required of the applicant, and shall be verified by the applicant under oath.

When the provisions of this act have been complied with, the director, on report of the board, will issue to the successful applicant a certificate of registration or a license, as the case may be.

21. Every registrant or licensee under this act shall display his certificate or license in a conspicuous place in his principal office or place of business or employment.

Every registered structural engineer shall have a seal, the impression of which shall contain his name and the words, "Registered Structural Engineer, Province of ," with which he shall stamp all documents and plans.

22. Every registered structural engineer who continues in active practice shall, annually, on or before a date to be fixed by the board, renew his certificate of registration, or license, and pay the prescribed renewal fee. An expired certificate may be restored, at the discretion of the board, by the payment of a restoration fee.

A registered structural engineer who retires from active practice for not more than five years may renew his certificate upon payment of all lapsed renewal fees.

23. The board shall from time to time fix the scale of fees to be charged for the examination and registration of applicants, for the issue of certificates and licenses, for the renewal of certificates and licenses, and for the restoration of lapsed certificates and licenses, such charges to be at all times subject to the approval of the minister.

All fees shall be paid in advance of the issue of any certificate or license, and no such certificate or license shall be considered in force while any renewal or penalty obligation is charged against it.

24. The board may by a three-fifths vote revoke any certificate or license upon written notification to the holder

thereof, giving him not less than thirty days' notice of an opportunity for a hearing, upon proof that such certificate has been obtained by fraud or misrepresentation, or upon proof that the holder of such certificate or license has been guilty of malfeasance or gross incompetency in the exercise of his profession.

25. The department shall keep a record, which shall be open to public inspection at all reasonable times, of its proceedings relative to the issuance, refusal, renewal, suspension and revocation of certificates and licenses. This record shall also contain the name, number, place of business and residence, and date and number of the certificate or license, of every registrant and licensee with whom the board has dealt.

25. Each of the following acts constitutes a misdemeanor, punishable upon conviction by a fine of not less than $ nor more than $:—

(a) The practice of structural engineering, or an attempt to practise structural engineering, without a certificate of registration as a registered structural engineer, or a license issued under the several provisions of this act; each day of so practising, or attempting to so practise, shall constitute a separate offence.

(b) The making of any wilfully false oath or affirmation whenever an oath or affirmation is required under the terms of this act.

(c) The affixing of a registered structural engineer's seal to any plans, specifications, estimates or drawings which have not been prepared by him or under his immediate personal supervision.

(d) The violation of the provisions of section 21 of this act.

All fines and penalties shall inure to the Department of Registration, and shall be recoverable with costs under the provisions of the law respecting summary convictions.

27. On and after a date six months subsequent to the date upon which this act comes into effect, neither the province, nor any county, township, municipality or village shall engage in the construction or maintenance of any public work of a structural engineering nature unless the plans, specifications and estimates have been prepared and the construction supervised by a registered structural engineer with qualifications appertaining to such work; provided that nothing in this section of the act shall apply to such public work if the estimated cost for the completion of the same does not exceed two thousand dollars.

28. Any person entitled to be registered under this act who shall neglect or omit to be so registered shall not be entitled to the benefits and protection thereof while such neglect or omission shall continue.

29. No provisions of this act having to do with penalties and restrictions shall be operative until one year after the passing of the same.

The American Association of Engineers has issued the following bulletin: "Attention is directed to Senate bill 2507, providing for a department of public health in the United States government. The bill authorizes a secretary of public health; a first assistant secretary, who shall be 'a man trained in medical science and eminent as an authority on public health and sanitation problems; a second assistant secretary, who shall be a man expert in the science of vital statistics and public health; and a third assistant secretary, who shall be a woman trained in the science of medicine or nursing and of public health.' Without entering into the discussion of the necessity and desirability of a department of public health, it seems necessary that such a department should be provided with an engineer trained and experienced in sanitary engineering. The problems of sanitary work are less medical than engineering. The American Association of Engineers, in pursuance of its policy to give attention to legislation affecting engineers, is conferring with prominent sanitary engineers of the country in regard to the bill's lack of provision for sanitary engineering services."

ROADS OF BRITISH COLUMBIA*

BRITISH COLUMBIA has approximately 14,600 miles of road open for traffic in the unorganized districts—namely, outside of incorporated municipalities. These roads have been constructed and are now maintained at the sole expense of the Crown. About 5,000 miles of the highways may be classified as main trunk roads, subject to a heavy mixed traffic of motor-trucks, touring-cars, ore-wagons, lumber-wagons, and the more ordinary traffic of farming communities. There are also about 5,000 miles of second-class road, which carry less volume of traffic, but which normally have to support the very heavy loads connected with mining, logging and other industries. The remaining roads are generally merely roads of access, subject to little traffic, and which, though costly to construct, especially in the mountainous or heavily timbered sections, are generally fairly cheap to maintain. In addition to the roads proper —that is, roads for ordinary wheeled vehicles—there are over 8,000 miles of trail, many of which in course of time will be widened out and improved, so as to form finally a part of the highway system.

Sixty Miles of Bridges

In connection with the provincial highways there are nearly 60 miles of bridges, of which nearly 3 miles are steel structures, built either purely for highway purposes, or built as composite highway and railway bridges, in association with one of the several railway companies. At least 13 miles of British Columbia's bridges are timbered truss spans, the remainder being timber trestles.

The provincial government has also installed and maintained 48 ferries, of which the majority provide a free service. There are also 3 subsidized steamboat services plying periodically on the interior lakes.

Within organized areas the provincial government has given material assistance to the various rural municipalities in connection with the construction of the trunk roads, and particularly in connection with the laying of improved surfaces. The formulation of a definite policy for dealing with work of this nature is under consideration by the administration.

Within the five years preceding 1919, the provincial government, by contribution or direct expenditure, has applied a sum of at least $600,000 towards such work, which, among other existing benefits, is represented by about 40 miles of paved surface within municipal areas.

The province of British Columbia embraces an area of 388,263 sq. miles, or, in other words, is practically as large as France, Spain, Portugal and the Netherlands. Of this area, less than ½ of 1% is organized into municipalities; while of the total population (approximately 400,000) only 14% is resident in the unorganized areas.

Extensive Banks of Gravel

Generally speaking, the rocks found in British Columbia are unsuitable for the construction of water-bound broken-stone roads, but as a compensation there are in the majority of sections extensive banks of gravel which provide suitable material for water-bound gravel roads, or, by selection, excellent material for concrete or other hard surface. The cost of special surfacing, except on the most heavily travelled ways in the neighborhood of towns, is, of course, prohibitive, but careful experiments are being made of surface treatment of ordinary gravel roads, and in many other directions, with the object of determining upon a form of construction suitable to each locality, and which, taking the first cost, maintenance charges and quality of surface into account, will be very greatly superior to the class of road which has so far been built in the outlying districts.

The public works department, which is responsible for the highways of the province, is thoroughly alive to the necessity of further extending the highway system for the benefit, not merely of the province, but of Canada as a whole. The necessity of intercommunication by road with

*From Handbook of British Columbia, published (1919) by the Legislative Assembly, Victoria, B.C.

the rest of Canada and with the United States has given definite form to the plans. A very thorough inquiry is being made to determine beyond dispute as to what—from every point of view—will be the best route for a trans-provincial highway, as far as it affects British Columbia.

There is a highway leading from Alberni, at the head of the Alberni canal, Vancouver island, down through Nanaimo to Victoria; thence by steamer to Vancouver; then south across the Fraser river and up the left bank of this river to Hope. Improvements to this road have been carried out from time to time, and there does not remain a great deal of work to be done to make this section a thoroughly first-class highway. At Hope it becomes necessary to cross the coast range of mountains by one of three routes—either up the canyon of the Fraser river to Kamloops; up the Coquihalla valley and down the Coldwater to Merritt, and thence to Kamloops; or up the Silver creek valley and down the Roche river to Princeton.

Some Prominent Highways

The Silver creek route to Princeton, and its continuation, would be an excellent highway, but one which will require a considerable amount of work to complete. From Princeton to Cascade via Fairview, Greenwood and Grand Forks is a good road, and the construction of approximately 30 miles of road from Cascade to Rossland was decided upon early this year. At this time a fairly good road was being used from Rossland to Nelson. From the latter point a ferry-steamer is taken to Kootenay Landing, and from Creston the remainder of the highway leading through Cranbrook, Waldo, and Fernie to Crowsnest is completed and will not be a difficult matter to improve.

With regard to the other roads of the province, there is a heavily travelled road leading in a northerly direction from Ashcroft, through Clinton and Soda creek, to Quesnel. From there the road to Fort George will require to be located and built, as the old route is not desirable. Within a very short time it would be possible to complete the road leading west from Fort George along the Nechako river to Fort Fraser; thence up the Endako river to Burnt creek, and then down the Bulkley river to Hazelton.

The provincial government has also a road leading from Waldo, near Fernie, up the Kootenay river to Columbia lake, and thence along the Columbia river to Golden.

Banff-Windermere Road

There is another projected highway known as the Banff-Windermere road, which is destined to link up the east Kootenays with western Alberta. The route of this highway commences at Sinclair, on the Kootenay river valley road north of Windermere, proceeds along Sinclair creek to the Kootenay river valley; thence along the Vermilion river to the Vermilion pass (elevation 4 662 ft.) at the Alberta boundary. Of this road about 23 miles was constructed between the years 1912 and 1914, leaving about 48 miles to complete. Early in 1919 the uncompleted section was taken over by the Dominion government, who entered into an agreement with the British Columbia government to complete the road before the expiration of 4 years. This projected highway is situated midst magnificent mountain and valley scenery, a large area of which is being reserved for park purposes, and will eventually afford access to the Banff national park in Alberta.

Some idea of the magnitude of the work carried out upon this highway system may be given by stating that for the ten years preceding 1919, the expenditure upon extension, improvement and repair to the roads, trails and bridges in British Columbia has been nearly $3,000,000 annually.

It is anticipated that the Lethbridge southeastern irrigation project embracing some 350,000 acres, of which the two big natural reservoirs, known as the Milk River reservoir and the Raymond reservoir form a part, will cost between $3,000,000 and $4,000,000. H. B. Muckleston is now preparing estimates.

Letters to the Editor

DRIFTING SAND FILTRATION IN TORONTO

Sir,—For a variety of reasons the writer is particularly interested in Mr. Howard's paper on drifting sand filtration in Toronto, published in the October 2nd issue of *The Canadian Engineer*. In the first place the process is a radical departure from long established practices in water purification; and, second, the drifting sand filter plant at Toronto has ever been enveloped in a fog of uncertainty respecting its cost of operation and practical performances.

In the winter of 1913-14 the writer was preparing a monograph for the American Water Works Association entitled, "Present-Day Water Filtration Practice," and learning of the probable decision on the part of the Toronto authorities to adopt the ver Mehr drifting sand system in the proposed 60,000,000-gal. (Imperial) extension to the existing slow sand system at that place, sought to obtain reliable information about it, that he might refer to it in his then forthcoming article on water filtration matters in general. He learned that Sir Alexander Binnie was alleged to be an advocate of the process, and as the time was short before his article went to press, he cabled Sir Alexander for a statement regarding it. Sir Alexander replied that the only plant of this type he had seen was a small installation in Wales, but that he was impressed by it and thought highly of its possibilities. Correspondence with certain public officials in Toronto, and even personal inquiry on the ground, developed only the same line of indefinite information.

Prior to May, 1913, a test plant having a daily capacity of 500,000 Imperial gallons was installed by the ver Mehr company near the old West Toronto pumping station, and on May 21st, 1913, turned over to the city authorities for official test. The results of this test were reported on by George G. Nasmith and F. Adams, of the Department of Public Health, Toronto, in an article which appeared in *The Canadian Engineer* for April 8th, 1915. This test was run between the dates of May 21st, 1913, and June 27th, 1913, and upon the results then obtained, and the recommendations of Dr. Nasmith, the ver Mehr company was permitted to put in a bid for the 60,000,000-gal. installation. Of the four bids tendered, the ver Mehr bid was $1,096,000 as against the other three of $1,177,000, $1,197,000 and $1,750,000 respectively, and the contract went to the low bidder

From the time the test plant was installed in May, 1913, until the present day the writer has endeavored to obtain information relative to the cost of operation and maintenance of the new filtration works, but his efforts have thus far been without definite result. The 1915 article by Dr. Nasmith was scrutinized in vain for light on this important point, and it is with regret that even at this late date Mr. Howard seems unable to give the profession any information on this vital phase of the matter. In reply to a question by Col. Longley, he sweepingly dismisses the subject with the reply that "there are no figures available as to cost of operation." Personally the writer does not see how any discussion of the merits of the drifting sand filter can be of definite utility until some one is ambitious enough to relate the whole story and advise the public, not what this plant cost to build as compared with what either a slow sand or the established type of rapid sand system might have cost, even going so far as to grant that all three would produce an equally satisfactory effluent, but what are the actual costs of operation and maintenance.

A somewhat mysterious phase in operating results was described by Mr. Howard at the last annual meeting of the New England Water Works Association. In reply to a question by Mr. Caird relative to whether alum passes the filter, Mr. Howard states that "there is a slight trace of aluminum hydrate in the filtered water." He further said:—

"We experimented by passing the filtered water through

very fine filter papers and found that the hydrate was not decreased in any way."

Now this is suggestive. All water filtration men know that where aluminum hydrate is in suspension in water, that hydrate, no matter how finely divided the particles may be, can be removed by passage through fine filter paper; that is, if the texture is fine enough and there are enough thicknesses of the paper. If the resulting filtrate then reacts alum, the presence of undecomposed alum is proved, and not aluminum hydrate. All this suggests that as a sequence of a practically negligible period of coagulation in this process, undecomposed alum may be passing the filters, later perhaps to become decomposed and form an undesirable deposit in the pipes, or to cloud the filtered water as it leaves the taps in the city. If not so decomposed, an active corrosive agent is thus present in the filter effluent. This point requires clearing up by Mr. Howard.

From the information before him, the writer is not prepared to accept without question the Toronto drifting sand filter as a reliably efficient and economical process of water purification.

It is ingenious, and seems to satisfy the Toronto authorities; but it is not apparent that the citizens of Toronto desire the drifting sand process at any cost, and it seems quite unusual that a plant which has been operated as long as has this one, should not have developed accurate costs, a statement of which the profession at large, and the taxpayers of Toronto assuredly, would appear to be justly entitled to.

When these figures are published, it is to be hoped that they will be so decisive as to set at rest, once and for all, the doubt now existing in the minds of a great many water works engineers respecting whether Toronto is actually receiving acceptable water purification service at reasonable cost.

GEORGE A. JOHNSON,
Colonel, Utilities Division,
Construction Division of the
United States Army

Washington, D.C., November 25th, 1919.

RECOVERY OF VALUABLE CONSTITUENTS OF GARBAGE

Sir,—The writer has read with much interest the article on various methods of garbage disposal by Samuel A. Greeley which appeared in last week's issue of your paper, and while agreeing with him on many of his points, yet his article leaves a rather one-sided impression on the mind of a layman, and as councils are oft-times made up of laymen and as Mr. Greeley has hinted at various methods of garbage disposal, such as feeding to hogs, sorting and reduction, it may be well to ask Mr. Greeley if he will be good enough, to write another article, giving some information, which he must be in possession of, such as spreading of disease amongst cattle and hogs by feeding them on garbage.

No doubt Mr. Greeley knows of many cases where epidemics have broken out among swine and cattle as a direct result of some one trying to make a few dollars by taking what is admitted to be the most filthy and unsanitary stuff and attempting to turn it into pork, beef, or anything else intended for human consumption.

If Mr. Greeley has not heard of any such cases as referred to, perhaps he will not mind writing to Kitchener, Ont., or to the Ontario Board of Health, Toronto.

Mr. Greeley also refers to the system of sorting, such as is done in "Buffalo, Rochester, Pittsburgh, Columbus and elsewhere," and admits that the revenue derived from the sale of such sorted material "does not usually much more than pay for the cost of operation."

But, Mr. Editor, is the dollar the most important item? Very few people have any desire even to poke their nose inside of a reduction plant of any kind, much less work in it. Take, for instance, the plant just outside of Detroit. Everybody who has travelled in the neighborhood of that plant can bear testimony to the very rich odors arising therefrom, even without going within a mile of the plant; and, sir, what right has any one for the sake of making a few dollars, to ask men and women to work under such conditions as must obtain, around any reduction plant, no matter what kind or where situated.

The ordinary refuse coming from a number of houses daily is of the most filthy kind, and contains many things that are indescribable. The writer has studied the question of garbage disposal for some years, and has reached just one conclusion: Burn it up, either in the open or in an incinerator, and do this just as soon as possible after the garbage leaves the house, as it only takes a few hours to produce maggots, flies and odors, all of which tend to make things unpleasant for any person handling house refuse.

Here are a few of the kind of goods the writer has seen brought to an incinerator practically every day in the year: Dead cats and dogs; decayed fish, poultry and all kinds of meat; filthy rags, which have often been used for bandages on all kind of sores; rotten vegetables, fruits and canned goods; and other filth not decent to mention. If any person does not believe this, he can prove it for himself by going into an incinerator or reduction plant—not for a few minutes, but staying there for a few hours—and the writer is convinced that once a person has done that, he will be of the opinion that incineration is the only sane, sanitary, sure way of dealing with garbage with the least possible chance of spreading disease and the greatest security for a healthy, sanitary and clean town or city.

J. G. PICKARD,
President, Canadian Incinerator
& Furnace Co., Ltd.

Toronto, December 1st, 1919.

The Engineer's Library

"COST KEEPING AND CONSTRUCTION ACCOUNTING"

By G. Ed. Ross, associate member of the Northwest Society of Highway Engineers, and assistant secretary, chief accountant and cost keeper of the Phez Co., Salem, Oregon; 172 pp. and cover, 5½ by 8¼ ins., cloth bound; price $2.50 net, post paid.

After a detailed review of the author's experiences, and testimonials to his system of cost accounting, there follow 42 pages of descriptive features which were used very satisfactorily, says the author, by the Oregon State Highway Department, of which he was formerly secretary and auditor. Pages 76 to 129 are devoted to illustrations and explanations of forms recommended. A chapter on organization follows, with a suggested organization chart. The volume concludes with a discussion of the value of good cost records and the field for competent cost accountants.

The author says: "I spent 12 years doing in large organizations what I have written about, and my book is an outline of what has been actually accomplished rather than a theoretical story of what ought to be done. It is a practical book from cover to cover, and sets forth a principle which is being used on many of the larger projects on the Pacific coast, as well as by some manufacturing firms and a great number of counties. I have attempted to handle the subject in as readable and interesting a manner as a technical subject of such a nature would warrant, and have woven into the narrative a little poetry and some statements of a general nature to get away from the dryness which frequently is found in such publications."

British Engineering Standards Association.—Thirteenth report of work accomplished, covering period from August 1st, 1917, to March 31st, 1919; 124 pages and paper cover, 5½ by 8½ ins.; published by the association at its office, 28 Victoria St., Westminster, S.W.1, Eng.

PLANNING AND DEVELOPMENT OF CITIES IN ONTARIO*

By Thomas Adams
Town Planning Adviser to the Dominion Cabinet

THE present Planning and Development Act of Ontario deals largely with planning as a matter of fixing the location and dealing with the widening, extension. and relocation of highways and parkways. Its proper description should be a highway or street planning and development act. It does not deal with town planning on the broad lines of other town planning acts which have to do with the regulation of the use of land and the character of building development in cities, towns and rural areas.

The general object of an act should be to secure proper sanitary conditions, the economic use of land and amenity and convenience in connection with the laying out and development of land. Thus the first things to get are proper sanitary conditions, which include the consideration in advance of the facilities needed to supply land and buildings with economical means of drainage, sewerage, water supply, etc.

Under the question of amenity, which may be interpreted as agreeableness of surroundings, there would be comprised the prescribing of space about buildings and the character of buildings and their surroundings.

Conditions Influencing Highway Traffic

Under convenience, the main consideration is that of highways and streets, and particularly the provision of wider main thoroughfares. It is impossible, however, to deal with this question of convenience in relation to traffic without considering at the same time the height, density, setback and use of the buildings served by the streets or highways.

You can neither plan a street or highway system as if it were a separate thing from the building development of the city, nor unless you have previously taken into consideration the zoning of the city into factory, residential and other districts.

We cannot strain the word amenity too far. What I mean is that we cannot interfere to any great extent with vested interests in property merely to obtain an agreeable or picturesque effect. If, however, the industries of a city or district depend for their success on certain restrictions on private interests in property, we should not consider it unreasonable to make these restrictions. The only things that are beyond question in connection with the restriction of private interest in property for the public welfare are the things that relate to health.

We should move at certain minimum standards in regard to what are proper sanitary conditions in respect of air space around buildings. Having arrived at those minimum standards, we say they should be insisted upon by law and that no compensation should be payable, even if our insistence upon them means that there is a loss of capital or revenue to the owner of the land.

Proper Sanitary Conditions Essential

This distinction between things that interfere with the health and welfare of the community and the things that are merely necessary for convenience and beauty is recognized in all laws relating to compensation under British and American constitutions. It is recognized in all town planning laws, and because it permits so much to be done by way of regulating the use of the land without payment by the community for compensation to private interests, it makes it of additional importance that town planning schemes should have for one of their main objects the securing of proper sanitary conditions, amenity and air space.

The provisions of the Ontario act may be briefly described as follows:—

To enable cities to have some control over the land outside their boundaries, the act sets up a new area called the "urban zone." The area of this zone comprises the land within five miles of a city boundary on all sides, or within three miles of a town or village boundary. The act recognizes the subordination of a town or village to a city, or of a village to a town.

The objection to this feature of the act is the power it gives to one municipality to have jurisdiction within the area of another municipality without having first provided the means to permit the planning of the zone to be carried out by the municipality in direct control of the area, or by co-operation between the adjacent municipalities.

Scope of Powers Restricted

The act gives a city, town or village, power to prepare a general plan, but sets forth that such plan shall deal with the restricted purposes of highways. parkways, boulevards, parks, playgrounds and other public improvements. The plan is not required to show or deal with the relationship of the highways to the character, density, height and use of buildings on the abutting lots, nor is there any provision in the scheme for preparing a preliminary and tentative plan and submitting same to the board so that their approval can be obtained in advance of incurring the expense of getting a certified plan, making the subdivision conform to the general plan.

It is difficult to see what really important object is attained by such a plan that could not be obtained by means of by-laws, or at least that does not merely consist in getting streets properly connected. The fact that the scheme does not touch buildings and sanitary conditions means that the planning of the size and form of lots is of little utility. They may be planned for the wrong purpose even if it is the purpose most agreeable at the moment of planning to the city and the owner.

Not until the city or town is planned in regard to its building development and until the location and densities of its factory and residential areas are thought out, can any highway or lot planning be settled in a satisfactory manner.

Section 9 permits the control of the planning of streets on adjacent subdivisions, so that they will be treated as one and fit in with each other. This is useful if it were part of a comprehensive scheme of town planning.

Non-Elected Town Planning Commissions

The act also permits of the setting up of a town planning commission. This commission must be a body corporate and exercise all the powers under the act. Thus, we may create an undemocratic body to override in certain respects not only the municipality that creates it, but the municipalities within the urban zone which have had no part in creating it. Hamilton has hesitated to appoint such a commission because it would give power of administration to a non-elected body with no direct responsibility to the tax-payers. If Hamilton objects to creating a commission of its own selection to deal with the planning of its highways, how much more should the municipalities within five miles, but outside of Hamilton, object to a non-elected body having control of the planning of their subdivisions and highways.

In Ontario we need an act that will really be a planning and development act, and that will show greater recognition of the value of self-government.

It is, of course, essential that adjacent municipalities—whether cities, towns or townships—be made to co-operate in controlling the development of the suburban area that rings in our cities and towns. It may be necessary that the cities be given the power to plan these suburban areas, but they should only be permitted to exercise that power after it is demonstrated that the municipalities outside the boundaries are unwilling to exercise it themselves.

It is contended that the existing planning and development act does not meet the needs of cities such as Hamilton, London and Windsor, which have been giving consideration to the desirability of preparing comprehensive town plans. These cities want a great deal more than the power to control the subdivision of land in the zones lying within five miles of their boundaries. The value of this power to them is shown by the fact that they have taken no steps to give it

*Address delivered last week at the Southwestern Ontario Town Planning Conference.

effect. What these cities require may be summarized as follows:—

1. The present act should be modified so as to permit the municipalities in the urban zones, which lie outside of the cities and towns, to prepare their own schemes if they wish to do so, while retaining the power to the city or town to include the outside area in their scheme in the event of lack of co-operation of the outside authority to prepare its own scheme or a joint scheme.

2. A special official with town planning qualifications should be appointed under the act to assist the Railway and Municipal Board to administer the act and to advise local authorities.

3. Provision should be made requiring each municipal council to make a survey of its area and conditions, and provide for assistance being given by the Provincial government in the preparation of topographical maps of all districts which are in course of development.

4. Provision should be made for securing co-operation between municipal councils and owners of land so as to give permanent effect to restrictions on the use of land relating to such matters as building lines and use and character of buildings.

5. The following powers should be granted under the act to municipalities:—

(a) The suspension of any powers in the municipal act, subject to approval of the Railway and Municipal Board, so far as the suspension is necessary for the proper execution of any scheme.

(b) Power to remove or demolish buildings which may be erected in contravention of the provisions of a scheme, after the scheme has been approved, as well as after proper notice is given and while the scheme is being prepared.

(c) Provision, not only for paying compensation for injury to owners of property, but also for obtaining for the city half of the increased value given to any property by reason of benefits accruing to such property by the scheme.

(d) Power to prescribe certain areas to be used for dwelling houses, apartment houses, factories, warehouses, shops or stores, etc., and to fix the height and character of the buildings in these areas.

(e) Exemption for any city or town from claims for compensation in respect of any requirement of the scheme which restricts the use of land for the definite purpose of health of the inhabitants or the amenity of the district, e.g. in regard to fixing factory, business or residential areas, the space about buildings, the percentage of lots that can be covered with buildings, or in regard to the height, character and use of buildings so far as such exemption may be regarded as reasonable by the Railway and Municipal Board.

(f) Power to compulsorily acquire land the same way as under the housing act of the province, without cumbersome process of arbitration; and to acquire land in excess of the amount needed to widen a street or construct a new street through a developed area, and to re-sell such land after the improvement is made.

(g) Power to fix building lines and reserve land on unbuilt-upon areas for new main thoroughfares.

(h) Power to classify any land to be used for different kinds of agriculture, horticulture, open spaces, etc., and to recommend a special system of assessment in relation to such classification of uses.

(i) Power to prevent noxious trades, bill-boards, etc., where injurious to the surroundings.

(j) Power to rectify or alter any existing subdivisions, including the pooling of lands of several owners, and the roads and streets abutting or adjacent thereto; and to initiate the planning of the subdivision of land in advance of its being placed on sale for building purposes, for the purpose of bringing owners of adjacent lands into line with any comprehensive scheme.

(k) Power to prevent building on low-lying and unsanitary lands pending reclamation and until provided with sanitary arrangements at the expense of the owners.

(l) Power to obtain proper representation of the municipal councils on town planning commissions and limitation of spending power of commissions to the cost of preparing schemes. Expenditure on execution of schemes to be subject to approval of municipal councils.

(m) Power to classify roads or streets (after zoning into factory, business and residential districts) as follows:—

(1) Main arterial roads.

(2) Secondary roads, being roads for general or local traffic.

(3) Industrial roads for access to industrial districts.

(4) Residential roads, being roads used primarily for access to residences.

(5) Parkways or boulevards, being roads which serve the purpose of either a main or secondary road, a portion of which is dedicated for ornamental purposes, etc.

The Provincial government should be asked to incorporate provisions in the present act or to frame a new act to cover these requirements; and so framed as to permit local authorities to prepare comprehensive schemes of town planning.

ZONING CITIES FOR TO-MORROW*

By W. J. Donald
Secretary, Chamber of Commerce, Niagara Falls, N.Y.

THE zoning or districting of towns and cities is, to my mind not only an integral part of town planning but even the fundamental basis on which all town planning must rest. This becomes apparent when one defines zoning as the determination of the character and intensity of the use to which lands within any given area are to be put. To be sure, zoning has been carried on in Canadian and American cities with little or no reference to town planning, and town planning has frequently been attempted without detailed consideration of the purposes to which the area is to be put.

In order to preface further discussion by securing a clear understanding of what zoning actually is, it seems wise to explain in detail what one city, Niagara Falls, N.Y., proposes to do. One of the first projects undertaken after the preparation of the final city plan, was the adoption of a zoning scheme. Note that a city plan had been prepared or at least almost completed first. The zoning map which was prepared, frankly recognized the plan, and the use to which lands may be put in Niagara Falls will keep in mind the general plan. This zoning plan provides for different uses for different sections of the city, and for varying degrees of intensity of use in different sections. After all, city planning is fundamentally a recognition of the fact that there must be differentiation between different sections of a city.

The Niagara Falls plan provides for six classes of zones or districts, for which different conditions of use, height and area of buildings are provided.

1. Residence districts for single family dwellings only, occupying an area of not over 30% of the lot, not more than 45 ft. high, and with side lots of 10 ft.

2. Residence districts devoted to residence purposes including two-family and group houses for not more than ten families, occupying an area not over 50% of the lot, not over 45 ft. high, and with side lots of 10 ft.

3. Apartment house districts, devoted to apartment houses and "tenements," with a height not exceeding the width of the street on which they face.

4. Commercial districts devoted to retail and wholesale trade, and incidental industry, requiring not more than five employees.

5. Industrial districts in which so-called "light" industry, not emitting undesirable noise, fumes or smoke, are permitted.

6. Unrestricted districts in which any industry, however disagreeable or dangerous, may locate.

In any of these classes of districts, uses permitted in a more restricted district are allowed. For each class of district, there are refinements as to use, area and height of buildings which we need not discuss here, but which in the

*Address delivered last week at the Southwestern Ontario Town Planning Conference.

practical application of the proposed zoning ordinance, occasion a great deal of discussion and call for a great deal of careful consideration and careful and patient explanation and educational work.

The word "zoning" is doubtless somewhat misleading. I have already observed that in Canada some people think of it as some sort of procedure for controlling the growth of the environs of growing cities. I wish its application might be extended to cover such a purpose in American cities, but I think that more progress is likely to be made in that direction in Canada than in the United States. This use of the word originated in Germany, where districting efforts gradually assumed the character of zones, the care of which often proved to be the area within the original walled town. A glance at any zoning map in the United States would give little indication of "zoning" in the German sense, but our "zones" are merely districts varying widely in area and location.

Despite the effort of professional city planners to popularize the more accurate word "districting," the people where districting work has been carried on persist in using the word "zoning," so let the people rule. "Zoning" it shall be.

Dependence of Zoning on City Planning

It is worth recalling that the Niagara Falls zoning ordinance was prepared as an integral part of a city plan for Niagara Fals. Unfortunately, this is not true of all other cities. I do not believe that it is true of any Canadian city, with the possible exception of Halifax, or of most American cities. You will be interested to know, I am sure, that in America, Nova Scotia was first to provide for the districting of towns and cities—as early as 1904. In 1909, Los Angeles passed an ordinance controlling the use of lands, making the ordinance retroactive. That ordinance has been declared constitutional, not only by the Supreme Court of California, but also by the Supreme Court of the United States, as a proper exercise of the police power. Of course, many municipalities had long ago created fire and building districts in the interests of public safety, but the extension of districting to include health and general welfare has been of this recent origin.

When Berkeley, Cal., adopted an ordinance in 1913, it provided for an optional districting plan. The ordinance provided for a large number of residence districts and permitted the citizens to petition for restrictions. An Ontario law for cities of over 100,000 provides for the establishment of residence districts on petition from which apartments, industries, etc., are excluded. More recent state laws and city ordinances provide for the zoning of the whole town or city.

Now, it is evident that petition ordinances and laws, such as exist in Ontario, do not anticipate any ordered planning of a city. Districting done under such laws is purely spontaneous, undirected and sporadic. It may be actually unwise and undesirable, as experience in Berkeley has actually proven. Home-owning petitioners seem prone to ask too little for the protection of their neighborhoods, though some have been known to ask too much. The difficulty in both cases is that the petitions were not based on a considered and sound interpretation of town planning fundamentals.

Topographical Knowledge is Basic

Basic in any town-planning work is a knowledge of the topographical background on the basis of which the main lines of transportation are likely to be determined. The availability of water transportation is very likely to determine the location of industry, especially heavy industry. Industry seems to naturally seek low-lying lands and waterfronts. Residences seek higher and dry areas. Topographical conditions are certain to affect the direction of prevailing winds by which smoke and fumes are carried. Mountains and hills, lakes and rivers are likely to determine, in part, the location of parks and public recreation grounds. All of these factors, especially the location of railroads and industry, affect very definitely the use to which lands are likely to be put.

It is scarcely necessary to argue, therefore, that zoning is an integral part of city planning, and that if zoning does not happen to grow out of town planning, the preparation for zoning should be so intensive as to relate the work to every other phase of city building and particularly those phases which are affected directly by topographical features.

Zoning as Basis of Intensive Town Planning

But there are many phases of town planning that are of secondary importance and very dependent upon the character and intensity of the use to which lands are to be put. If we could tell in advance just how all the land in and about Hamilton will be used 5, 10 or 25 years hence, how much easier it would be to plan properly for parks and open spaces, school grounds and play grounds, sewers and water and gas mains, arterial streets and parkways, quiet residence streets, street car lines and industrial switching tracks and belt lines, as well as public buildings.

Presuming that having once determined on the main principles of a plan for the city, based on topographical and other natural conditions, it is possible to determine also with reasonable certainty, the likely economical use of all lands in the city, let us consider in detail a few advantages to be gained.

Consider for a moment the interrelation of all these uses. Having once determined the proper general location for heavy industries, it is then possible to plan for adequate water terminals and, possibly, industrial canals; for railway sidings, terminals and belt lines; for street ways properly paved and wide enough for heavy, slow-moving trucks; for sewers designed to carry off the refuse of industry; for water mains possibly carrying raw rather than filtered water.

Industrial Houses

But modern industry, despite so many labor-saving devices, still calls for labor. Industrial housing areas should be reasonably close to the industrial areas, so that workmen may walk to work, yet far enough away and in such direction that the evils of "nuisance" industry may be minimized. Residence sections determine the location, number and even character of schools and their grounds. Schools in industrial housing areas should most certainly be planned as community centres, and there is an especial need for adequate playground space surrounding them. Incidentally, it would be an excellent improvement if some sort of park might be interposed between industrial housing areas and the nearby industries where employment is found.

Streets

In turn, to preface the planning of streets by zoning the city, will result in important economies. Most cities have shown little or no discretion in the planning of streets. The humble owner of a home in a section largely occupied by working men must pay for pavement on a street as wide as that used by his motor-driving employer. It is a question whether streets in industrial housing areas should be paved at all. Indeed, it has been suggested that there should be no public traffic ways in front of working men's houses, but merely pathways for pedestrians and play space for children, while traffic to the street should be served only by a paved alley for delivery purposes.

Lots and Blocks

Along with uniformity of street widths and street improvement should go uniformity of the depth of lots and size of blocks. Industry frequently is handicapped by the smallness of blocks. Sometimes, they get round the difficulty by securing the privilege of blocking or closing streets which should be left open. In fairness to both, industry and the public interest should not come into conflict in such a fashion. The conflict should be anticipated by zoning. Industry has a right to know where it can expand economically without coming into conflict with public opinion or public rights.

Workmen in turn should not be required to buy lots that are unnecessarily deep and viciously narrow. Lots that are too deep represent an unnecessary expense to the indus-

trial wage-earner. Moreover, they are a constant invitation to the building of rear houses, another vice for which the working man pays, if not with cash, at least with life and blood.

Transportation

The intensity of the use to which land is put has a particular bearing on the question of the daily movement of the population, without going into questions of technique on the control of the area and height of buildings, or the legal questions involved; we may consider the significance of this question, as it affects the requirements of a city, especially transportation.

I believe it is the custom of every city outside of New York to crave a distinguishing skyscraper. As a matter of fact, New York investors in skyscrapers have long since become disillusioned, as the average high building in New York brings a return of about 2%. The first skyscraper pays excellently for a time—its offices are light and airy and highly desirable, but once flanked by others, the returns soon reach the unprofitable level. Excessively intensive use of land has actually proven uneconomical to the property owners responsible.

Intensive use of land is moreover a liability to the community. Lower Manhattan could not empty itself into its own streets. Intensive use of building lots should call for correspondingly wide streets. Europe does not build towers of Babel such as one finds in New York, and such as other cities imitate. Intensive use calls for a corresponding provision of land for open space—of land for streets on which pedestrian, wheeled and car traffic may be accommodated. It is especially related, therefore, to the provision of street car service.

As a matter of fact, zoning in New York City grew out of the evident necessity for limiting the heights of buildings. The Heights of Buildings Commission soon discovered that it would be necessary to discriminate between sections of the city in any effort to regulate heights. A zoning commission was the logical consequence. Limitations on the intensity of use have therefore a very direct bearing on other city planning problems. In particular, the limitations on the possibility of providing transportation demand limitations on the use of land.

Enough has been said to indicate that the zoning of a city—that is, the determination of the character and intensity of its use—has a very definite bearing on every phase of city planning.

Does Zoning Pay?

I think I ought to add that zoning is one of the fundamentals of city planning which, fortunately, costs nothing except the costs of administration. I believe, too, that by permitting a careful anticipation of the city's future needs, it saves the city thousands of dollars that would otherwise be wasted. If time were available, I should like to discuss how zoning protects and stabilizes property values, how it protects the property owner against depreciation and the refusal to renew loans, how it protects the moneylender who loans on property, and how in general it protects the valuation on which the city bases its taxes.

W. A. McLean, Deputy Minister of Highways for Ontario, in an address to the Electric Club, Toronto, gave an outline of the present highway situation in Ontario. The need of the province in this connection is, he said, for a system of highways with continuous maintenance which would be reasonably passable. Ontario might well, he thought, increase its expenditure on good roads, but, on the other hand, economy must be practised, and roads built in proportion to the traffic which they accommodate. Close to large cities, where there is a heavy concentration of traffic, construction must be heavy in proportion, while similar construction in rural districts would not be justified. It would be out of the question to adopt one type of roadway throughout the province. There are, he said, 142,000 miles of highway in Ontario, and a large proportion of this mileage is surfaced road.

ETHICAL AND PRACTICAL SIDES OF TOWN PLANNING*

By Noulan Cauchon
Consulting Engineer and Town Planner, Ottawa

THE basic idea in town planning is the ethical side of the question; that is, man's right to live and the necessity for the survival of the race. One cannot recall too frequently Ruskin's great saying that "there is no wealth but life."

The fulfilment of this principle is accomplished through the technique of economics, such as controlling transportation, width of streets, height of buildings, the area of lots which may be covered, and the cubical contents of the rooms and buildings thereon. These are all but means toward the end of securing sunlight and air and the other conditions which are indispensable to health and amenity; and in the final analysis to secure the highest efficiency in the unit of manpower and consequently the maximum of production.

This is the justification for town planning as understood to-day. The artistic side of it evolves as the truthful expression of the purpose in view.

90% of City Buildings Doomed

As is frequently reiterated, a city no more than an individual can live unto itself. It depends upon its environment for the nature of its development; that is why in our planning there should be no hard and fast line separating urban and rural conditions; the one should blend into the other; they are complementary to each other.

You should plan broadly and largely, and with vision to the measure of your faith in the future of the country, as that is the basic power sustaining the development of the city. While your plans should be exhaustive, they should only be carried out as your progress and needs warrant. You should not only plan the future extensions of your city towards the country, but you should also replan your existing city.

I believe that in twenty-five or thirty years, practically 90% of all the buildings existing in our Canadian cities will have disappeared and been replaced by others more suitable to the purpose. The buildings will have disappeared from one of three causes:—

First, a number of them will have fallen down.

Second, a number will have been burned down.

Third, others will have been torn down by reason of the development of the city demanding new construction to meet the economic necessity of greater earning power to carry the charges on the increased values of the land.

The problems of Hamilton are the problems of every other city and town in Ontario to the degree of their population and development, and what Hamilton is to be congratulated upon is the manner in which it has fearlessly tackled these problems and is seeking their solution.

Railway Problem Comes First

The first thing which must be tackled is the solution of the railway problem, which is a special one on its own merits in every locality, due to physical and other conditions. I have had the privilege of making, in collaboration with W. F. Tye, of Montreal, a report on the railway situation in Hamilton. This report was accepted unanimously by the city council of Hamilton, who are still fighting for its accomplishment. Subsequently I made a report to the Hamilton Plan Commission on the general development of the city, resting upon the economic conditions of the surrounding country.

The whole of Eastern Canada from Quebec westerly to about Brandon, Man., is absolutely dependent upon the United States for its supply of coal, and should that fail, or to the extent that it may fail, must our railways, our industries and even our home fires slacken to a point unpleasant to contemplate. The moral to be drawn from that is that we must develop our potential water power to lessen as much as possible in certain directions our dependence upon coal. But we

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*Address delivered last week at the Southwestern Ontario Town Planning Conference.

must be very careful in the development of that water-power that the capital cost of it must not approach the cost of development of steam power, or little will have been gained.

The trend of rural population in Canada from 1872 almost to date has continually increased towards the city, thus lessening the production from agriculture and increasing the cost of living. This has been my reason for advocating the settlement of returned soldiers and others upon lands around the cities and towns, where they may be induced to take up agricultural pursuits under intensive cultivation, the whilst enjoying the amenities of civilized life, good roads, doctors, churches, schools, and the greater efficiency which they and their families can thereby attain.

This principle and its application in Ontario and Quebec, with the further crop insurance and aid of irrigation, has been recommended for thorough investigation by the parliamentary committee which recently sat at Ottawa to consider Soldiers' Civil Re-establishment, and I trust that the proposal for the diversion of the Grand River towards Toronto, Hamilton and the Niagara Peninsula, will shortly be taken up for investigation. The map of the country just referred to, showing the proposed metropolitan district and the numerous towns within it, emphasizes the necessity of not only planning the individual towns, but also the relationship which there is between them from a transportation and a sanitary point of view.

[NOTE.—At this point Mr. Cauchon's formal address ended and he began to show slides, discussing each in informal manner. The following, therefore, is a general outline report, not verbatim, of the remainder of his speech.—EDITOR.]

Plans were shown of the proposed railway re-organization in the city of Hamilton, and the advantages of the uptown station were set forth. In this connection, Mr. Cauchon pointed out that the new by-law being submitted to the city of Hamilton for the Guelph and Galt Hydro Radial, seemed to assume that the station would be at Stuart street, in conjunction with the present Grand Trunk station at that point. The "Hydro" have accepted the common entrance of the Tye-Cauchon plan, but have not yet declared themselves upon the uptown station.

Attention was drawn to the newspaper rumors that the "Hydro" might require or expropriate the Dominion Power & Transmission Company's radials centering in Hamilton. In view of the acknowledged convenience of the uptown feature, both as regards the T.H. & B. station and the radial terminal, Mr. Cauchon asked what would happen if the latter were purchased by the "Hydro." Would they maintain two terminals, one at Stuart street where passengers would have to get off and pay an extra fare uptown, and maintain the present radial terminal, or would they attempt to abandon it and bring all the radials into the Stuart street station? He advised the citizens of Hamilton to see to it that they obtain the uptown station for both steam and radials.

Views were shown illustrating the proposed developments for Hamilton, including a view of the turning tracks in the New York Central station as demonstrating that the proposal for Hamilton was quite feasible and good in operation.

Railway Problems in Various Cities

Views of Ottawa were shown, illustrating the railway conditions there and the fact that trains come from the main line of the Grand Trunk 4,000 ft. to the Central Station and back out again,—a thousand feet greater each way than what is proposed for Hamilton, and lacking a greater facility that Hamilton will have in being able to operate its trains around the curve and out again instead of backing in and out.

Referring again to Hamilton, illustrations were shown of the proposed Mountain Road development in its economic and also its scenic advantages, the proposed widening of Ferguson Ave. from the station to the base of the Mountain Park, and the development of the old quarry into a stadium for sports. Under this plan 3% grades for haulage to the top of the mountain are secured, and a by-law is being submitted at the coming municipal election to provide for $50,000 as a beginning on these roads.

The railway problem in London, Ont., as reported upon by Mr. Cauchon, was fully illustrated and reasons given why, although the conditions were somewhat similar to Hamilton, owing to the differences in levels an elevated cross-town track seemed to him the best solution.

By way of interest, slides were shown of the plan of Delhi, India, which is an elaboration of diagonal streets; and a plan of Paris, showing Haussmann's work in the replanning of that city.

To illustrate the proper treatment of the relation of buildings to scenery in regard to public institutions on the Mountain brow, such as the new hospital, Mr. Cauchon showed views of Durham Cathedral, the Walls of Carcasonne in Southern France, the Alhambra of Granada, the Acropolis of Athens, a terrace at Amalfi in Southern Italy, and the great Dufferin Terrace at Quebec.

Niagara-to-Windsor Highway

Views of the proposed mountain-side highway from Niagara to Hamilton were shown, and the point emphasized that if a great highway were carried through Southwestern Ontario from Niagara to Windsor, it would form part of a great transcontinental highway from New York to Chicago. The evidence that this is the proper route for attracting American travel to Canada, he said, is that it is the speedway of the Michigan Central and American freight through Canada, by reason of its shortness.

Mr. Cauchon concluded his address by showing some views of Niagara Falls, N.Y., where the railways are acutely congested, and explained the solution which he had submitted at the request of the Chamber of Commerce. The keynote of this plan is the lowering of the crossing of the Niagara gorge by about thirty feet, enabling grade separation and better railway approach to the bridge on both the American and the Canadian sides, which, he said, would permanently relieve the congestion at the border.

GARDEN CITY'S LOW INFANT DEATH RATE*

FIFTEEN years ago a group of reformers built a new town on garden city principles, 34 miles from London, to prove, among other things, that a union of town and country life was possible and practicable, and that as a result there would be healthy children and the rate of infant mortality would be reduced.

The time of proof has come. "It is an interesting fact to record," says the Garden Cities and Town Planning Magazine, "that during the eventful and difficult year of 1918, the infant mortality rate in Letchworth was 30 per thousand births. This is the lowest figure it has ever reached (in 1917 it was 36) and is by no means due to a low birth rate."

A garden city is not a mere residential community. Herein it differs from the garden suburb. It is intended to be "a small town, organized for modern industry, of a size that makes possible a full measure of social life, surrounded by a permanent belt of rural land." It does not aim to be a bigger, but rather a better town, where the normal activities of life shall have the best chance of expression.

Dr. Helen MacMurchy recently stated that every year in Ontario nearly 10,000 children under the age of five go to their graves. A recent bulletin of the Toronto Bureau of Municipal Research states that during the last decade, through the activities of the Department of Public Health, the infant mortality of Toronto has been reduced from 182 per thousand in 1909 to 103 in 1918. The general rate for the whole of Canada was recently given as 140 per thousand; for Great Britain, 139; for Sweden, 96; for Norway, 86; for New Zealand, 76.

Considering the many factors that contribute to the destruction of child life, the fact that only 30 children out of every thousand failed to survive at Letchworth, during the year 1918, cannot fail to carry conviction of the soundness of town-planning principles to any fair-minded observer.

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*From Conservation.

TOWN PLANNING CONFERENCE AT HAMILTON

ABOUT 150 delegates (from municipalities, boards of trade and other organizations) to the third annual town planning conference of southwestern Ontario, assembled last Thursday and Friday at Hamilton, Ont.

Proceedings commenced on Thursday morning with the registration of delegates, and a meeting of the executive for the purpose of striking committees.

At the noon luncheon, Dr. Horace L. Brittain, Bureau of Municipal Research, Toronto, gave an address on "Citizen Co-operation and Government." Owing to the vaccination requirements enforced at the international boundary, Lawrence Veiller, secretary, National Housing Association, New York City, who was expected to speak, was unable to attend, and Thomas Adams, town planning adviser, Ottawa, spoke in his place, taking as his theme, "The Housing Situation from an International Standpoint."

Mr. Adams stated that the housing question was essentially international, for in every country there was a shortage of houses, and men were finding difficulty in obtaining places of abode. The question had become very acute during the war in the U.S.A., and the government had found it necessary to build houses for workmen employed in shipbuilding, munition plants, etc. Specialists had been sent to Great Britain to study the question, with the view to building permanent dwellings.

Millions Spent in United States

Under the auspices of the Housing Corporation, Department of Labor, controlled by Mr. Eidlitz, New York, $60,000,000 had been allotted to the United States Shipping Corporation, and $100,000,000 to the Labor Department to finance housing schemes, which had been started in all parts of the United States—in Philadelphia, Wilmington, Norfolk, Charleston, Portland, etc.

In his opinion, said Mr. Adams, the scheme which had obtained the best result in the creation of a garden suburb, was that at a village outside Camden, N.J.

The housing scheme had been started by the federal government under pressure, owing to war conditions, and unfortunately that same spirit of doing things only under compulsion still predominated, with the result that although $100,000,000 had been expended on good houses, congress had decreed that no more houses were to be built.

Contrasting conditions in Canada with those in the U.S.A., Thomas Adams declared that Canada had no housing policy during the war, but was now able to commence a policy of reconstruction without adopting extravagant housing schemes.

The housing policy in the Dominion is the result of co-operation between federal and provincial governments, and soon after the armistice, provincial governments were called into conference at Ottawa in order to draft legislation for good housing.

The federal government decided to loan $25,000,000, and an Order-in-Council of February 20th, 1919, gave the conditions of the loan, and recommended:—

Conditions of Federal Loan

1. That a provincial scheme of housing be prepared.
2. That a house should not cost more than (a) $3,500 when built of timber or brick veneer, and (b) $4,500 when built of brick, stone, or concrete.
3. That the period of loan be (a) 20 years, (b) 30 years.

That loan be made to housing associations having a dividend paying less than 6% to its shareholders, and to individuals owning lots.

The order further states that the loan should be made to assist returned soldiers; and is not applicable to anybody having an income exceeding $3,000 a year. Conditions are laid down specifying the minimum size of rooms, external light and air, and sanitary arrangements.

Legislation had been passed in all provinces to deal with the housing scheme, but it was futile to pass legislation and not carry it into effect with good administration. Ontario had made the most progress, and had appointed a Director of Housing, J. A. Ellis, responsible for the carrying out of the scheme, and Mr. Ellis had an architect and a town planner to assist him. A large number of municipalities were taking advantage of the scheme, and had spoken for the full amount of money available.

Ottawa was cited as having the best scheme in Canada, and Mr. Adams described how 22 acres of land had been purchased at $3,000 an acre, and divided into 168 lots. Streets were planned to suit traffic requirements, a high spot selected as a clubhouse, 1½ acres devoted to children's play-ground, 1 acre to a bowling green, and 1 acre as a public space for recreation. Each purchaser of a lot paid towards this arrangement, which was so satisfactory that every lot was sold in a short time.

To Counteract Social Unrest

Private enterprises, said Thomas Adams, never attempted to solve housing problems. The best way to counteract social unrest was to house people well, and this could best be done by effective town planning. The chief weakness in a municipality was its peak in expenditure, because no attempt had been made to apply business principles to the government of a city. Money spent on local improvements and developing land by proper planning, would help to keep down wasteful expenditures. Wasted pavements, sewers, and water mains in front of vacant lots, should be made revenue-producing by building houses upon these properties. Money spent on constructive municipal work, in building houses, developing a city on some lines, was justified even if it meant an increase in taxes. The peak should be kept down by directing expenditure along productive channels.

The speakers at the afternoon session were S. Baker, city clerk, London, whose address was on "Municipal Government and Reconstruction," Sir John Willison, and J. A. Ellis.

Sir John Willison said the best council a city could have was one in which every element was represented, including labor, women and capitalists, viz., a council which maintained a close co-operation with public life. Good government was a matter of good citizenship, and an educative body should be created, and an endeavor made to inculcate duties of citizenship in public and secondary schools. He did not think that the reason given by some citizens, that many good men refused to serve their city because of the criticism or treatment given public men by the press, was a true one. As a rule, the men most successful in private affairs made the best public representatives on account of their training and business experience.

Ninety-seven Municipalities Adopt Housing

J. A. Ellis told of the work of his department in connection with the Housing Act. The housing scheme, said Mr. Ellis, was a matter of reconstruction, and a very important matter for all municipalities.

Ninety-seven municipalities had adopted housing, 70 municipalities were now building, and 93 proposed building next year. All cities, with the exception of three, one of which was now passing a by-law, and all towns, had taken advantage of the scheme. Next spring, it was anticipated, 5,000 houses would be built. A stage had now been reached, where a number of houses had been built in many municipalities, and the public were able to see the kind of house they may expect to obtain. Efforts had always been made to have municipalities follow the best lines to obtain the best houses with the best results.

Two items were both cheap and common, namely, sunlight and fresh air. The bureau had aimed at obtaining reasonably sized rooms, proper windows, a reasonable amount of land round the house, with the house so placed as to obtain the maximum of fresh air and sunlight, and good sanitary conditions. The result had been that 95% of the houses built, were absolutely satisfactory and first class in every way.

Mr. Ellis stated that some weeks ago he went over 80 houses. The total amount of taxes, insurance and payments ranged for $26 to $32 a month. Houses of a similar class were rented at $35 to $40 a month, which proved that houses

could be bought cheaper under the housing scheme, than if they were rented.

He was strongly in favor of the scheme, as it encouraged thrift, and allowed families to be brought up in good sanitary homes, and he hoped that private houses built in the future will follow the plans and ideals of municipally-built houses under the housing scheme.

Several delegates took part in the ensuing discussion, J. P. Geoffrey, Galt, maintaining that the provincial fund would soon be exhausted, and not meet the situation during the next five or six years. He maintained that the only solution was the duplication in Ontario of the building and loan system in operation in Philadelphia, where there are 160 building associations.

He declared that recreation grounds and play-grounds were essential for contented young manhood, and said that 10% of the land in Galt is devoted to parks and playgrounds.

Thomas Adams expressed his satisfaction that it had been possible to obtain a special act allowing a city to manage itself as it wishes. Some of the causes of dissatisfaction in civic government were the numerous spending bodies. He considered it democratic that citizens should elect a council, who would in turn elected their own mayor, and favored a continuity of government, giving as an example, 18 aldermen in office for three years, six retiring each year. This system would assist in eliminating commissions, would centralize administrative power in one body, and give executive power to the city officials, who should draw salaries commensurate with their responsibilities.

Advocates Civic Research Bureaux

Dr. Brittain was invited by the chairman to make proposals as to action by the conference in general in carrying out suggestions made in his address earlier in the afternoon. Dr. Brittain suggested that cities of over 30,000, establish local bureaux, and co-operate with the Dominion Bureau of Research. By so doing, the Dominion bureau could retain the services of specialists such as engineers and auditors, who would visit the civic bureaux when required, and give expert advice.

Speaking at the evening session to a representative gathering of citizens, civic officials, members of the Board of Trade, and delegates, J. A. Ellis maintained that every municipality should have the right to govern itself, and shoul any municipality have a plan or scheme requiring legislation to make it effective, his personal opinion was that such legislation should be given. No government would refuse a popular demand, but it was essential to know definitely what was wanted.

The two addresses of the evening were given by Thomas Adams, town planning expert, and Noulan Cauchon, consulting engineer, Ottawa. Both addresses are printed in full upon other pages of this issue.

Will Interview Ontario Cabinet

FoHowing Mr. Adams' address, delegates from London, the Border cities, Brantford and Chatham, expressed their approval of the suggestions made in the address, and the meeting, by a unanimous standing vote, supported Mr. Coppley's resolution: "That this conference approves of the town planning scheme, and resolves that the chairman appoint a deputation representative of all municipalities to see the government with reference to the new legislation, and amendments as suggested by Thomas Adams."

Friday morning's session commenced with reading of the reports of the honorary and corresponding secretaries, and the consideration of resolutions recommended by the executive committee. The following is an extract from the report of the corresponding secretary:—

"The last town planning conference of southwestern Ontario was held in October, 1916. Remarkable developments have taken place since then along many lines, but provincial town planning has not developed with the times. Standing to-day and looking back three years since last we met, we see with a clearer vision than before the great need and the great importance of planning our cities, towns and rural communities, but we seem to be no nearer the accomplishment of our ends than at the last convention. Notwithstanding appearances, however, much foundation work has been accomplished during the last three years, and many towns have appointed town planning boards. I believe we are are now on the eve of greater accomplishments.

New Legislation Needed

"Lack of adequate legislation has also interfered seriously with local town planning progress. The Planning and Development Act of 1918, while a recognition of the importance of planning highways, urban zoning, organization of town planning boards, etc., has been found defective. When we came to apply the act in Hamilton, the city council was alarmed at the wide-open door to large expenditures, and refused to appoint a commission under the act.

"The Hamilton council refused to proceed under the act, and they were justified in their course of action. The Hamilton town planning board is not appointed under the act because the taxpayers are not sufficiently safeguarded, and consequently the board's hands are tied and we are in a large measure marking time. The town planning board in Hamilton is simply a committee of the council, without sufficient appropriation to carry on its work.

Object of Conference

"One object of this conference is eo educate the public and the municipal councils along town planning lines, to create public sentiment and bring it to bear upon the provincial parliament. We cannot magnify the importance of town planning too much, and in order to accomplish our ends we need the help of the women of this convention.

"Each municipality has its own peculiar problems, but in order to solve them, a comprehensive city or town plan should be secured, adopted, approved by a provincial board and registered. In Hamilton we are after such a city plan, which shall co-ordinate various very ambitious individual projects in the course of development. For example:—

"1. The harbor board is working on a vast harbor scheme preparing for a future seaboard town.

"2. The housing commission is building scores of up-to-date dwellings for workingmen, having all the conveniences.

"3. The parks board have hundreds of potential acres to develop for future generations.

"4. New railway plans have been projected by Messrs. Tye and Cauchon; these have been adopted by the city council, and stand ready to be worked out.

"5. Several millions of dollars have been voted as collateral security in connection with Hydro-radial lines, terminals, freight yards, etc.

"6. A highway commission has been appointed to lay out roadways which shall make Hamilton the hub of southwestern Ontario.

"7. A proposition is now before the city council, having in view the beautifying of the Mountain Face park, which is five miles long, and a most unique natural asset belonging to the city, which is awaiting development.

"There are narrow streets to widen, boulevards to build, slum conditions on the outskirts of the city to clean up, factory, commercial and residential districts to restrict. A city plan is absolutely necessary to remedy defects and to facilitate improvements, and yet up to date so many hindrances obstruct the forward movement that apparently we are no nearer attainment of a city plan than three years ago, when we met at our last convention.

Considerable discussion took place during the consideration of the resolutions, and the objection was raised that the conference was attempting to cover too wide a scope of municipal affairs.

A resolution was passed urging the department of education to provide for the education of children in the duties of citizenship. The convention also endorsed a suggestion that fire chiefs be instructed to address school children in fire prevention.

It was resolved that the town planning convention considers it imperative that no factories emitting smoke and noxious fumes be allowed to locate on the side of the municipality from which the prevailing wind blows, and demands the adoption of a by-law preventing the improper location of such factories.

A letter from the London Trades and Labor Council, asking that the conference use its efforts to have the housing commission's regulations made easier, and that provision be made for cheaper houses, provoked much argument, and it was decided to forward the letter without comment to the federal and provincial housing commission.

The speakers at the luncheon were: W. J. Donald, secretary, Chamber of Commerce, Niagara Falls, N.Y., whose address is published in full upon another page of this issue, Louis Black Duff, Welland, and Thomas Adams, who spoke on "Town Planning—Does it Pay?"

In the course of his speech, Mr. Adams said that the first thing to be considered in town planning was transportation, as the railways and waterways were with us and could not be moved. Having planned those, the next problem was the zoning of the city, dividing it into factory, business, and residential districts, but just as much respect should always be paid to agricultural developments outside, as to manufacturing elements inside a city. The Niagara peninsula should be considered as a whole in transportation and zoning questions. He maintained that there was absolutely no necessity to have subways or tunnels to carry traffic in Canada, provided the principles of town planning were carried out.

The first thing to be done was a survey of existing conditions with a view to obtaining data, and these facts, with their relation to each other should be considered by practical men. Science and practical experience should work side by side. It costs nothing to zone a city except the expenditure in preparing a scheme and its administration.

The conference was brought to a close at the afternoon session by papers on "Looking Ahead," by Mrs. Dunnington Grubb, landscape architect, Toronto, Mayor McBride, M.P.P., Brantford, and W. A. Crocket, M.P.P., Barton.

According to newspaper rumors, the Dominion government appears to be unwilling to allow the Hydro-Electric Power Commission of Ontario the privilege of constructing the proposed St. Lawrence canalization and power development. It is said that the government considers that the proposed work should be a federal undertaking.

Excavation work is well advanced for the extension which the Steel Company of Canada, Limited, are making to their bolt and nut building. This extension will provide an additional floor space of 60,600 sq. ft. The extra accommodation will be used partly for storage and shipping and partly to enlarge the facilities for the various manufacturing processes. The estimated cost of the work is $200,000. The new building will be four stories high, of reinforced concrete construction. F. G. Peden, of Montreal, is the architect, and the Anglin-Norcross Co., Ltd., of Montreal, have the general contract.

Three-quarters of a million dollars have been spent by the Administrative Commission of Montreal, during the present year, on permanent street works and repairs, according to a report given out by the Department of Public Works. A total of $519,903.43 has been spent on new paving. The following amounts have been expended on repairs: Street paving, $97,157.82; street crossings, $32,490.86; permanent sidewalks, $25,878.05; temporary sidewalks, $21,501.74; water-bound macadam, $64,022.04; levelling unpaved street, $13,842.26; oiling streets, $27,612.99; and repairs to bridges and tunnels, $11,904.44.

In an address to the members of the Peterboro Board of Trade, Thos. Adams, town planning adviser of the Dominion government, spoke of the housing problem and said that any town that offers bonuses to manufacturers shows signs of weakness. He said: "We have not solved the problem of social organization of industry. The present condition means strikes, slumps, disorganization, even among well-paid workers, a growing burden of taxation, rapidly increasing because we have no well-defined organization to plan our cities, as we do our industries. City planning has to do with transportation, streets, waterways and buildings. No streets should be less than 66 ft. wide. In the residential district 40 ft. is ample, but in the congested districts they should be 100 ft. wide."

CONCRETING IN COLD WEATHER

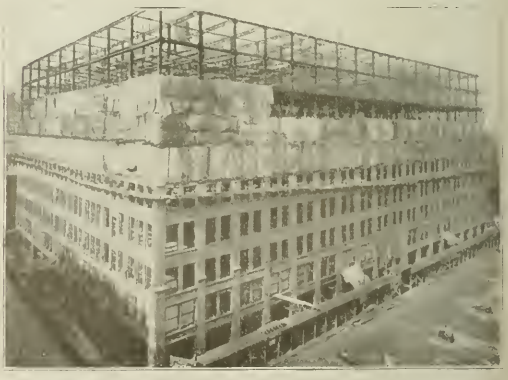
IN the October 23rd issue of *The Canadian Engineer*, there was published an article by A. E. Wells, of Chicago, president of Wells Bros. Construction Co. of Canada, Ltd., on the advantages that accrue to owners of buildings as a result of continuing concrete work during cold weather.

"Primarily the reason why building has been inactive in winter," says Mr. Wells, "is that concrete does not harden so rapidly when its temperature hovers near freezing. But

RAND, MCNALLY & CO.'S PUBLISHING PLANT

we heat our homes, offices and stores, and coal is a comparatively small operating cost. We are to-day able to enclose a structure, warm it with simple coke stoves, heat aggregates prior to mixing with Portland cement, and keep the concrete or mortar warm until hardening has occurred."

A few days ago Mr. Wells kindly mailed to *The Canadian Engineer* the two accompanying views showing how his firm has enclosed with tarpaulins the floors of buildings



REGINA WAREHOUSE, ROBERT SIMPSON CO., LTD.

upon which they desired to do concrete work in cold weather. The Regina warehouse of the Robert Simpson Co., Ltd., is entirely a reinforced concrete structure. The Rand, McNally & Co. publishing plant is a steel building with concrete floors and fireproofing.

J. B. Nicholson, Ltd., contractors, of Hamilton, Ont., are moving their head office to the Excelsior Life Bldg., Toronto, and are establishing a concrete-products plant at Toronto, although they intend to retain their present office and plant at Hamilton. The firm is specializing in the design and construction of circular reinforced concrete bins for coal, grain and oil storage.

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INVESTIGATION OF CONCRETE-PROPORTIONING

TWO weeks ago eight engineers from various parts of the United States and Canada held what may prove to be one of the most important meetings in the history of concrete. Called as a special session of two sub-committees of the American Society for Testing Materials' concrete committee, this meeting is of historic interest in the engineering world in that it constituted the first definite co-operative step toward taking the proportioning of concrete materials out of the realm of the empirical and into the limits of science and certainty.

At the last annual meeting of the American Society for Testing Materials, Sanford E. Thompson, chairman of the committee on concrete and concrete aggregates, stated that there is no more important subject in civil engineering to-day than the finding of proper methods for proportioning concrete, and he intimated that it was high time that the guesswork be eliminated from plain and reinforced concrete construction. He argued that there is now a sufficient abundance of accurate data from independent sources to enable the committee to establish certain fundamental principles, the lack of which has hitherto caused most of the general fog surrounding the simplest problems in concrete proportioning, and he urged the society to take some definite steps along this path.

Largely as a result of Mr. Thompson's plea, the members of the concrete committee decided to try to establish whatever basic truths there may be underlying Prof. Abrams' fineness modulus and water-cement ratio theories and Mr. Edwards' surface area theory. Both of these gentlemen were expected to attend the Chicago conference, which was held at the Lewis Institute, November 17th and 18th, and Prof. Abrams was there, but unfortunately Mr. Edwards was snow-bound in Dakota while returning from an inspection of a bridge for the United States Bureau of Public Roads. The arguments and data on behalf of the surface area method were ably defended, however, by H. F. Gonnerman, first assistant to Prof. A. N. Talbot of the University of Illinois; A. T. Goldbeck, engineer of tests, U.S. Bureau of Public Roads; and Roderick B. Young, of the engineering laboratories, Hydro-Electric Power Commission of Ontario.

The Bureau of Standards, which has taken a prominent part in the various discussions that have centered around the fineness modulus and surface area methods, was represented by J. C. Pearson. The chairman of the meeting was Cloyd M. Chapman, engineer of tests, Westinghouse, Church, Kerr & Co., Inc., who has taken a very active interest in both methods, and whose laboratory has conducted a considerable number of tests. The other sub-committee members present were P. J. Freeman, of the Pittsburgh Testing Laboratories, and Prof. M. O. Withey, of the University of Wisconsin.

Every one of the eight above-mentioned engineers have at their disposal the most modern laboratory facilities for concrete research and tests, and are in the best possible position for accomplishing some really revolutionary results by co-operative effort,—joint interpretation of pooled experience.

As a result of the two-day conference, it was decided that these eight and several other outstanding laboratories should join hands in the carrying out of a definite program of tests which was formulated at the conference, and the results of which will very likely throw considerable light upon some of the points now disputed by the advocates of one or the other methods of proportioning, and may also demonstrate that the fineness modulus and surface area theories are not so diametrically opposed as their sponsors still appear to believe. At least one investigator, Roderick B. Young, of the Hydro-Electric Power Commission of Ontario, believes that these methods are in harmony on all essential points. He brought out some interesting evidence to support his belief in a valuable article, "Analysis of Concrete-Proportioning Theories," which was published in last week's issue of *The Canadian Engineer*. Mr. Young summed up very concisely the outstanding points of both methods, and showed how the Hydro-Electric Power Commission's tests substantiate both the surface area and water-cement ratio theories.

The present schedule of co-operative tests has been designed to cover all points in dispute and includes the use of stone, gravel and slag and various combinations of these three materials, so that the laws formulated may be entirely general.

REPORT OF J. C. T. O. STATUS COMMITTEE

SEVERAL months ago the Joint Committee of Technical Organizations appointed a status committee, with H. G. Acres, hydraulic engineer of the Hydro-Electric Power Commission of Ontario, as chairman. This committee has just presented its report, which is published in full in this issue. It recommends legislation based upon somewhat different lines than the bill which was recently drafted by a special committee of the Engineering Institute of Canada and which was intended to serve as model legislation to be introduced into the various provincial legislatures.

It is claimed that the basic difference between the J. C. T. O. and E. I. C. bills is that the former is popular legislation and the latter class legislation. As proof of the fact that the J. C. T. O. bill is popular legislation, it is pointed out that it is applicable to any profession or even trade if so found desirable.

The E. I. C. is said to have attempted to legalize the definition of engineer, whereas the J. C. T. O. bill gives wide authority to duly constituted boards to say who is and who is not an engineer, without requiring those passed as engineers to fit any prescribed definition. In other words, under the J. C. T. O. bill an electrical engineer, for example, would be an electrical engineer merely because he was recognized as such by the board of governors of the electrical

engineering profession in his province, and he would not be entitled to practise as an electrical engineer until he was so recognized.

The J. C. T. O. bill may have decided advantages as compared with the E. I. C. bill and it should receive the careful attention and close study of all members of the Engineering Institute of Canada. If, upon discussion, it appears to present better chances of being adopted by the provincial legislatures, and if it is fair to all engineers and fulfils the need for protection through legislation, then it is the bill that is wanted and the E. I. C. should not hesitate to support it in lieu of their own draft. The report has been forwarded by the J. C. T. O. to the officials of the various technical organizations represented on the J. C. T. O., and should now be discussed by the members of those organizations.

In his letter of transmissal accompanying the report, Mr. Acres says:—

"This report has been prepared at the cost of a considerable amount of discussion and research, and is the result of a number of meetings of the committee which were held from time to time throughout the past summer and early autumn. Owing to the season it was, of course, very difficult to get the members of the committee together, and in stating that the bulk of the committee work was done by Messrs. Hynes, McEvoy, Chipman and Le May, which is a fact, there is no hint of reproach, as I know personally that most, if not all, of the other members of the committee were out of town for practically the whole of the period above mentioned.

"Whatever value this report may have in the estimation of those for whom it has been prepared, it has been the result of the active and sympathetic interest taken in the matter by the gentlemen above named, and the thanks of the Joint Committee of Technical Organizations is due them in full measure."

It will be observed by those who read the proposed bill, that Part Two is an ancillary act covering only structural engineers. The committee's idea is that Parts Three, Four, Five, etc., would be other ancillary acts exactly the same as Part Two excepting that Part Three could cover architects; Part Four, electrical engineers; Part Five, mining engineers; etc. An ancillary act would be passed for each profession in which the majority of members petitioned for registration; also for those professions in regard to which the minister of education might deem registration to be in the public interest.

The Status Committee does not appear to lay claim to any credit for originating the legislation which it advocates, as it is explained that the whole has been patterned largely upon legislation now in force in some parts of the United States.

It is understood, moreover, that the conclusions arrived at by the Status Committee as a whole do not necessarily represent the opinions of all of the individual members of the committee, but have merely been put forward in order to pave the way for discussion of controversial points upon which an agreeement must be reached before any united stand can be taken by the various technical organizations interested in the proposed legislation.

PERSONALS

Walter Sidney Harvey, who resigned last week from the engineering staff of the Toronto Harbor Commission in order to accept a position with Alexander Potter, consulting engineer, New York City, was born December 16th, 1880, at Swansea, Wales. Mr. Harvey was educated at St. Andrew's College, Swansea, and at the Swansea Technical College, and was then articled for three years to T. J. Scoones, consulting engineer, of Bristol and London. After completing his term as articled pupil, Mr. Harvey remained with Mr. Scoones for a further 2½ years as assistant engineer on the design and superintendence of construction of the following works: Gravity water system at Cheddar, Somerset; sea defence works at Barry, Wales; dry dock reconstruction at Bristol; and coaling station at St. Vincent, Cape Verde Islands, West Africa. From 1904-7 Mr. Harvey served as contractor's engineer for the British Insulated & Helsby Cables, Ltd., in charge of track work and street paving in connection with the Chesterfield electric tramways. Upon completion of this work he remained for a time with the Chesterfield corporation as chief assistant to the borough engineer in carrying out some double-tracking, road widening and sewer construction. He resigned from this position in order to become contractor's engineer for Robt. H. B. Neal, Ltd., in charge of the construction of sewerage works and pumping station at Weston-super-Mare, and of the widening of the William Wright dock at Hull. In November, 1910, Mr. Harvey came to Canada and joined the staff of the main drainage department, city of Toronto, on the design of storm sewers and interceptors. Six months later he went to Lethbridge, Alta., as assistant city engineer, subsequently becoming city engineer. In March, 1914, Mr. Harvey returned to the department of works, Toronto, as designing engineer of the sewer section. He resigned in May, 1918, to accept the position of construction engineer for the Leaside Munitions Co., Ltd., and was engaged in the construction of a 12-in. shell plant for the United States government. Although this plant was practically completed, it was not operated owing to the signing of the armistice. Last January Mr. Harvey completed all outstanding work for the Leaside Munitions Co., Ltd., and joined the engineering staff of the Toronto Harbor Commission as engineer of sewer design, and was engaged under the direction of Geo. T. Clark, designing engineer, in the preparation of schemes for storm and sanitary drainage for the water front development, and of designs for outlet extensions to the city's overflow sewers. Mr. Harvey's first work on Mr. Potter's staff will be at Warren, Ohio, where he will investigate the relative merits of several sources of water supply, appraise the present system and prepare plans and specifications for a new system. Mr. Harvey is an associate member of the Institution of Civil Engineers of Great Britain, and was the recipient of the 1908 Telford premium awarded by that institution. He is also an associate member of the Engineering Institute of Canada and for the past year has been secretary-treasurer of the Toronto branch and secretary of several of that branch's most important committees.

J. W. Nelson, who has been a member of the Board of Control of Ottawa, Ont., for many years, has resigned in order to accept an appointment as superintendent of streets, succeeding George Little, who gave up the position owing to ill-health.

Norman M. Campbell, who has been associated with the Canadian Ingersoll-Rand Co., Ltd., for the past twenty years, has resigned his position as sales manager of that company, to take effect December 31st. He has been appointed managing-director of the General Combustion Co. of Canada, Ltd., manufacturers of industrial furnaces, with headquarters in the New Birks Bldg., Montreal.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand or proposed, contracts awarded, changes in staffs, etc.

ADDITIONAL TENDERS PENDING

Not Including Those Reported in This Issue

Further information may be had from the issues of *The Canadian Engineer*, to which reference is made.

PLACE OF WORK	TENDERS CLOSE	ISSUE OF	PAGE
Chippawa, Ont., highway bridge.	Dec. 6.	Nov. 27.	52
Crowland Tp., Ont., water mains	Dec. 18.	Nov. 20.	46
Montreal, Que., briquetting machinery	Dec. 14.	Nov. 6.	54
Winnipeg, Man., hydrants and valves	Dec. 15.	Nov. 27.	46
North Battleford, Sask., power plant equipment	Dec. 6.	Nov. 27.	52
Bamfield and Ucluelet, B.C., wharf repairs	Dec. 22.	Nov. 27.	52
Owen Sound, Ont., reconstruction of wharf	Dec. 12.	Nov. 27.	52
St. John, N.B., construction of grain conveyer equipment.	Dec. 9.	Nov. 27.	52
Saskatoon, Sask., sale of 750 k.w. generator	Dec. 12.	Nov. 27.	52

BRIDGES, ROADS AND STREETS

Banff, Alta.—Tenders addressed to R. C. Desrochers, secretary, Department of Public Works, Ottawa, will be received until 12 o'clock noon, Wednesday, January 7th, 1920, for the construction of a bridge over the Bow River at Banff, Alta. Plans can be seen and specification obtained at the Department of Public Works, Ottawa; at the offices of the District Engineers at Edmonton, Alta.; Winnipeg, Man.; Vancouver, B.C.; Equity Building, Toronto, Ont.; Shaughnessy Building, Montreal, Que.; at the post-offices, Calgary, Alta., and Banff, Alta.

Brampton, Ont.—Peel county council is considering construction of a permanent road from Main St. to the Grand Trunk yards on Church St.

Calais, N.B.—Contract let by provincial government to the Standard Engineering Co., of Toledo, Ohio, for repairs to the St. Stephen end of the International bridge, which spans the St. Croix River. The work is in charge of Engineer Paul Pocock, of Toledo, O.

Cobourg, Ont.—A representative from the Provincial Highways Department was here recently expropriating ten feet of land on each side of William St. This will be used for part of the transprovincial highway.

Finch, Ont.—Tenders will be received until 7 o'clock p.m., January 19th, 1920, addressed to J. G. Cameron, County Road Superintendent, Finch, Ont., for the construction of certain sections of road in the United Counties of Stormont, Dundas and Glengarry. Further information can be obtained at the office of the superintendent.

Hamilton, Ont.—Special road extension committee of Wentworth county council recommended that fifty miles be added to the county's road system.

Kingston, Ont.—Frontenac county council will give $8,000 for a bridge at Sharbot Lake, providing the government undertake and build the same.

L'Assomption, Que.—Town council let contract to M. Brouillette for construction of bridge. Estimated cost, $31,000.

Levis, Que.—Municipal council will call for tenders for the construction of a new road leading to the city hall. Two tenders submitted, one for $3,365 and another for $4,750, were not accepted, as the council only voted $1,600 for the work.

London, Ont.—City Engineer H. A. Brazier recommended to the city council that the old iron bridge over the River Thames, at Ridout St., be replaced next year by a $140,000 concrete structure.

London, Ont.—City Engineer H. A. Brazier will present to No. 2 committee of the city council a program of paving to be commenced in 1920, that will add 16 miles to the city's paved streets. According to Mr. Brazier, his department has in mind the need of putting 50 miles of streets in the city in the well-paved class.

Macdonald, Man.—On December 16th a by-law to authorize the issue of debentures to the amount of $175,-528.86 for the construction of a system of gravel roads will be submitted to the ratepayers. Secretary-treasurer, H. Grills.

Meaford, Ont.—A by-law to raise $50,000 for improving the leading thoroughfare of the town will be submitted to the ratepayers at the coming municipal election. The intention is to construct a reinforced concrete pavement to connect with the new county-provincial highway at both ends of the municipality. Clerk, Geo. G. Albery.

New Westminster, B.C.—Work on the reconstruction of the approaches and the construction of a sidewalk on Westminster bridge, involving an expenditure of $21,000 for both contracts, has started. The contracts have been awarded by the Department of Railways to the Nickson Construction Co. for the trestles and to Cox and Verge for the sidewalk. Both firms are Vancouver concerns.

Niagara Falls, Ont.—The city council intends to construct an asphalt pavement with Willite process on Benson St, between Palmer Ave. and St. Clair Ave. Estimated cost, $1,975. W. J Seymour, city clerk.

Ottawa, Ont.—City council intends to pave Rideau St. City clerk, N. H. H. Lett.

Peterborough, Ont.—County council will add to present road system by extending the Block road in Otonabee easterly.

Point Grey, B.C.—Municipal council decided to proceed with the grading of the boulevards of Maple St. and East Boulevard, south of Forty-ninth Ave., and will invite tenders for the installation of the four-foot-wide cement sidewalks.

Quebec, Que.—Contract for approaches and caissons of the Batiscan bridge has been given to the Gosselin Co., of Levis, Que. This bridge will unite the Montreal-Quebec highway and the cost will be $250,000. The masonry work will cost $150,000 and the superstructure about $110,000.

WANTED

Three assistant Highway Engineers, each capable of taking charge of the Highway work in one county. Duties to commence February 1st, 1920. Applicants to state salary expected, experience, qualifications, etc. All applications to be filed with the undersigned before January 19th, 1920.

J. G. CAMERON,
County Engineer, U.C. of S.D.G.

Dated at Finch, Ontario, December 2nd, 1919. 384

Russell County, Ont.—Tenders will be received by F. A. Senecal, Co. Rd. Supt., Plantagenet, Ont., until noon, Monday, December 8 next, for the construction of about 3½ miles bituminous-bound macadam road, 16 ft. wide. Plans and specifications may be seen at the office of the county engineer, V. E. Belanger, L'Orignal, Ont.

St. John, N.B.—According to a statement made by Hon. Peter J. Veniot, Provincial Minister of Public Works, plans are now before the Federal government for the improvement of the 91-mile St. Stephen-St. John Rd., and work will likely start next year.

Sarnia, Ont.—City council may construct a sidewalk on Ross Ave.

Sarnia, Ont.—City council may submit by-law to electors to authorize purchase of municipal asphalt paving plant. City engineer, J. A. Baird.

Shuniah, Ont.—Municipal council plans construction of a roadway from the boundary of Port Arthur to the proposed mills of the Great Lakes Paper Co. Clerk, H. A. McKibbin, Port Arthur.

Smith's Falls, Ont.—At a conference of Good Roads representatives held in Carleton Place a resolution was passed, asking the county councils of Carleton and Lanark to approve the designation of a county-provincial highway from Richmond to Smith's Falls, via Prospect and Franktown. It is expected that the councils will endorse the resolution and will forward it to the legislature for its approval. It is expected that a new highway will be constructed in the near future from Brockville to Smith's Falls. Should this programme be carried out, a main county-provincial road passing through this town and connecting Brockville with the Capital will be the result.

Toronto, Ont.—A deputation of municipal officials from Ontario county waited on Hon. F. C. Biggs, Minister of Public Works, urging that the government go ahead next spring with the completion of the interprovincial highway between Oshawa and Toronto. Mr. Biggs promised consideration of their demands.

Toronto, Ont.—A committee, composed of representatives of the King Street Merchants' Association, city officials, Ontario government, harbor board, railway companies, steamship companies, board of trade and branches of the law society, will meet the Board of Control to discuss the proposed widening of York St., the establishment of a new street between Bay and York, and the extension of University Ave. from Queen to Front Sts.

Vancouver, B.C.—The Board of Works has instructed F. L. Fellowes, city engineer, to proceed with macadamizing half a dozen blocks on Sixteenth Ave. Estimated cost, $3,200.

Victoria, B.C.—City council plans repair of part of Esquimalt Rd. City engineer, F. M. Preston.

Victoria, B.C.—City Engineer F. M. Preston reported to city council that it will cost $5,000 to resurface Esquimalt Rd. and $15,000 to resurface and regrade it.

Welland, Ont.—Contract let by Welland county council to B. G. Begy, St. Catharines, for construction of pavements in Bertie Tp. Cost, $18,000.

Wiarton, Ont.—Town council plans paving work to cost $8,000. Engineer, E. D. Bolton, Listowel, Ont.

Windsor, Ont.—City council let contract to H. Bondy, 321 Sandwich St. West, for sidewalks costing $23,000.

Windsor, Ont.—Under the leadership of Gustav L. Lindenthal, engineer, of New York, a movement is on foot to organize a corporation under the charter of the American and Canadian governments for the purpose of constructing a $28,000,000 expansion bridge across the Detroit River connecting Detroit and Windsor.

Winnipeg, Man.—Ratepayers passed by-law to provide for erection of new bridge over the Assiniboine River at Maryland St. City engineer, W. P. Brereton.

Winnipeg, Man.—Approximately $1,000,000 of debenture issues for road improvements will be voted on at the forthcoming rural municipal elections at Dauphin, Westbourne, Sifton, St. Andrews, Ellice, Birtle, Macdonald, Albert, Springfield and Gilbert Plains. Provincial highway commissioner, A. McGillivray.

York Township, Ont.—Township council gave third reading to a by-law to extend Woodville Ave., westerly to Don Mills Rd.

WATER, SEWAGE AND REFUSE

Brantford, Ont.—Plans are under way for the reconstruction of the waterworks system. Ratepayers will likely be asked to vote five or six hundred thousand dollars for this purpose. The work will be done sectionally. City engineer, T. H. Jones.

Chatham, Ont.—At a public meeting, called on November 28th by the city council for discussion of the three water schemes before Chatham, Engineer Proctor, of the E. A. James Co., Ltd., Toronto, explained his report, which recommends the adoption of the Lake Erie project at a cost of $600,000, as compared with $300,000 that would be required for the Thames scheme. After the public meeting the commissioners passed a resolution, recommending the Lake Erie plan to the citizens, and asking the city council to prepare a by-law to submit in January.

Drumheller, Alta.—In our issue of November 6th an item was published under above heading stating that water main extensions were planned by municipality at a cost of $5,000. We are now informed that this amount is additional to work already under way. This town voted $16,000 for water main extensions about last May or June and later in the season decided they would require this further $5,000 worth, or $21,000 in all. The work has been carried on under Hadden and Miles, Ltd., consulting engineers, Calgary, and the larger portion of it is completed. It has now been closed down for the winter and will be finished in spring.

Goderich, Ont.—An estimate of the cost of sewers on Elgin Ave. and Regent St. have been made and works committee recommended that these be the first sewers constructed in 1920. Clerk, L. L. Knox.

Halifax, N.S.—City council will construct a sewer on Decartaret St. City engineer, F. W. W. Doane.

Jenner, Alta.—An irrigation project, which will bring water to 270,000 acres in the vicinity of Jenner, has been presented to F. H. Peters, Commissioner of Irrigation for the Dominion government, who is located at Calgary.

Kingston, Ont.—City council passed by-law for the construction of sewers in Russell, Raglan, Macdonnell, Adelaide and Park Sts. City engineer, R. J. McClelland.

Levis, Que.—The Quebec Superior Board of Health have issued a new order to the city, requiring the installation of a new filtration plant. Plans must be in the hands of the board by January 1st, work started by April 15th and completed by September 15th.

Montreal, Que.—City will construct sewers on St. Zotique St. and Patricia Ave. City commissioner, R. A. Ross.

Napanee, Ont.—The town council has employed the E. A. James Co., Ltd., Toronto, to make a valuation of the assets of the Napanee Water Co., and to report upon what extension and improvements should be undertaken, providing the municipality purchases the assets of the company. The improvements will include filters, pumps and about four miles of new mains.

Peterboro, Ont.—William Kennedy, Jr., of Montreal, submitted a preliminary report to the Utilities Commission on the proposed filtration system. Estimated cost, $800,000. The commission will ask city council to have a by-law submitted to the ratepayers for its construction.

Windsor, Ont.—Engineers from the office of the E. A. James Co., Ltd., Toronto, are here reporting upon the valuation of the Windsor city waterworks system. The valuation is required by the city council in connection with the Border Cities Utilities vote, which may take place in January.

Sarnia, Ont.—City council may construct sewers on Confederation St., from Emma St. to John St.; on Nelson St., from St. Vincent to Collingwood St., and on Capel, Russell

Tarvia
Preserves Roads
Prevents Dust
Broadway, Tillsonburg, Ont., waterbound macadam treated annually with "Tarvia-B" since 1913

How Tillsonburg keeps its Streets firm, smooth and dustless—

Many towns and cities have just the same problem that Tillsonburg, Ontario, faced six years ago. They find their macadam streets do not stand up under the hard usage of modern traffic and are put to it to secure a remedy.

In 1913 Tillsonburg began using "Tarvia-B" on its main thoroughfare, shown above, which carries heavy traffic. After repeating this treatment yearly, Mr. C. H. Denton, Reeve, writes us:

> "I consider 'Tarvia-B' one of the best coverings for roads that we have ever used and have used it on Broadway for the last few years and I consider the life of the road has been saved at least to the extent of one-third, as we have had comparatively no repairs to make on it since we began using 'Tarvia-B.' And I believe that every macadamized road should have at least one coat of Tarvia every year, and if this is done I am sure that the road would last at least one-third longer."

Tarvia is the solution of the street problem for many Canadian cities and towns. Tarvia streets are free alike from dust and mud, with a tough, resilient surface that stands up well under heavy traffic, as the above photograph of Broadway shows.

Special Service Department

This company has a corps of trained engineers and chemists who have given years of study to modern road problems. The advice of these men may be had for the asking by any one interested. If you will write to the nearest office regarding road problems and conditions in your vicinity, the matter will be given prompt attention.

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WINNIPEG VANCOUVER
The Barrett Company LIMITED
ST. JOHN,N.B. HALIFAX,N.S.
SYDNEY,N.S.

and Milton Sts. Also drain on Exmouth St. City engineer, J. A. Baird.

St. Catharines, Ont.—Tenders will be called this week by City Engineer W. P. Near for sewage disposal plant.

Vulcan, Alta.—Council plans installation of a waterworks system. Estimated cost, $9,000. Reeve, E. W. Butchart.

Woodstock, Ont.—The Provincial Board of Health has given its approval to the proposed new intercepting sewer and sewage disposal scheme, and a by-law regarding it will be submitted to the people at the municipal elections the first of the year. The new plant will cost $100,000.

York Township, Ont.—Township council accepted reports of Engineer Frank Barber on construction of 6-in. water mains in Watford Ave. and East Earlsdale Ave.

York Township, Ont.—Township council let contract for the laying of water service pipes on Windermere Ave., Montye St. and Mulberry Crescent to G. Thompson, superintendent of the township waterworks.

LIGHT, HEAT AND POWER

Edmonton, Alta.—City Commissioners may have a new sub-station erected in West Edmonton next year. Estimated cost, $60,000. The extension of the lighting system in this district is also being considered.

Kitchener, Ont.—Hydro-Electric Power Commission of Ontario has asked the local Hydro Commission to consider the erection of three sub-stations in various sections of the city.

London, Ont.—An addition is to be built in 1920 to the Hydro station on Ridout and Horton Sts. at an approximate cost of $30,000. Work on the building, Engineer Buchanan stated, would probably begin in March.

Port Hope, Ont.—A convention will be held here in January of all the municipailties in the Trent Valley district to discuss plans for the purchase by the municipalities of the Trent Valley power plants and transmission lines now owned and operated by the Hydro Electric Power Commission of Ontario.

St. Boniface, Man.—City council plans improvements at power-house. Clerk, J. B. Cote.

Southampton, Ont.—Immediate action on the part of the Hydro-Electric Power Commission of Ontario will be asked by the northern municipalities interested in the proposed power development of the Saugeen River.

Winnipeg, Man.—City council let contract for steel towers for the second power transmission line to Point du Bois to the Canadian Bridge Co. for $136,163.

RAILWAYS

Bridgeburg, Ont.—The Toronto, Hamilton and Buffalo Railway Co. will construct the new line from Welland to the Canadian Niagara frontier at a point on the Niagara River, six miles below Bridgeburg, which will be the approach to the new bridge to be constructed over the Niagara by the C.P. Ry. The Canadian-Niagara Bridge Co., which will construct the new bridge, is capitalized at $8,000,000.

Calgary, Alta.—Application to electrify the C.P.R tracks constituting the spur line from Twelfth Ave. along Fifth St. East will be made by Assistant City Solicitor Marcus to the Railway Commission.

Gowganda, Ont.—Construction of a railway from Elk Lake to Gowganda planned by company headed by I. W. Soloway. Company will use 30-lb. rails and gasoline locomotives.

Guelph, Ont.—Hydro-Electric Power Commission of Ontario has offered to purchase the Guelph Radial Ry. for $150,000.

Regina, Sask.—City council granted permission for the construction by the C.P.R. of a spur track to serve the T. Eaton Co.'s warehouse.

Toronto, Ont.—City council authorized the extension of Bloor St. civic car line. Approximate cost, $200,000.

Toronto, Ont.—The plans for the construction of the Mount Pleasant car line are all prepared, and the Board of Control authorized the expenditure of $600 for printing them, and to call for specifications and tenders.

Toronto, Ont.—City council decided to submit to electors by-law to take over Toronto street railway in 1921. Also by-law to authorize issuing of $5,000,000 debentures for purchase of necessary rolling stock and building of extensions, including Mount Pleasant civic line and Bloor St. civic line extension in preparation for taking over T.S.R. in 1921.

Waterloo, Ont.—Town council decided to submit Hydro radial by-law to electors on January 1st.

FACTORIES AND LARGE BUILDINGS

Barrie, Ont.—Barrie is having a campaign to raise funds for a Y.M.C.A. building.

Belleville, Ont.—The Tivani Electric Steel Co., Belleville, proposes to erect a large new plant here.

Belleville, Ont.—Sketch plans for a ten-room public school building will be received by Arthur McGie, chairman, Sites, Buildings and Repairs, Board of Education, up to December 18th, 1919.

Bishop's Mills, Ont.—The erection of a consolidated school and a community hall are being considered.

Brandon, Man.—Extensive improvements to the public school are planned by the School Board for 1920. A by-law authorizing the raising of $150,000 for school improvements, will be submitted to the ratepayers.

Brandon, Man.—Movement is on foot by the Hospital Board to raise $300,000 for erection of a new hospital. Address, E. L. Christie.

Brantford, Ont.—Contract let to P. H. Secord Construction Co., of this city, for erection of an extension to plant of Wm. Paterson and Son Co. Approximate cost, $25,000.

Brantford, Ont.—A by-law will be submitted to the ratepayers in January to authorize an expenditure of $185,000 for hospital purposes, including $87,000 for a new isolation hosiptal and the conversion of the present isolation hospital into a nurses' home, $78,000 for improvements at the General Hospital and $20,000 for an addition to Brant Sanatorium.

Brockville, Ont.—Office Furniture and Supplies Co., Ltd., plan additions to plant. Managing director, H. K. Bowes.

Brockville, Ont.—H. W. Kreuzburg, Cleveland, Ohio, who has purchased Thousand Island Park, plans erection of new hotel there.

Calgary, Alta.—Dominion government may build a large aerodrome in this city.

Calgary, Alta.—J. Koloski, who owns the old post-office building, opposite the city hall, plans extensive alterations to same.

Calgary, Alta.—Plans for a municipal abattoir will soon be submitted by the city commissioners to the city council for consideration.

Calgary, Alta.—Hon. A. L. Sifton, Minister of Customs and Inland Revenue, Ottawa, will call for tenders at once for the new Calgary post office. The estimated cost is more than a million dollars.

Calgary, Alta.—A building permit for alterations to the extent of $6,000 on the property of M. R. Wallace, 203 Fourteenth Ave. East, has been granted. The work is being done by C. W. Pettifer. Bennett and White have taken out a permit for alterations on the Salvation Army headquarters which will cost $4,700.

BURLINGTON

STEEL BARS FOR CONCRETE REINFORCING

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ROUNDS
SQUARES
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BARS BENT TO SHAPE
FOR BEAMS, STIRRUPS ETC

FLATS
CHANNELS
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SPECIAL
SECTIONS

PROMPT
SHIPMENT

Chapleau, Ont.—The Dominion government contract for the construction of a new Indian boarding school here has been awarded to Gustiana & Zettler, Copper Cliff, Ont., whose tender was $89,000. The Kutchaw Plumbing and Heating Co., of Sudbury, Ont., has received the sub-contract for the plumbing, heating, wiring and water supply connections.

Chatham, Ont.—Contract let to J. B. Blakely, for the erection of a gymnasium to be added to the Salvation Army Hostel on King St. Approximate cost, $6,000.

Earl Grey, Sask.—A compaign is under way to raise $18,000 with which to erect a memorial hospital.

Galt, Ont.—Contract for excavation and mason work in connection with erection of a large annex to the Iroquois Hotel has been let to James Webster. Other contracts will be let. Manager, Mr. Bernhardt.

Glace Bay, N.S.—Contract let by school board to Alex McAulay for excavation work in connection with erection of new central school. Tenders will now be called for the heating and planking.

Gladstone, Man.—The Echo Flour Mills were gutted by fire, with a loss of $200,000.

Goderich, Ont.—Council considering erection of municipal aerodrome.

Halifax, N.S.—A new fire station will be erected in north end of city. Fire chief, Mr. Churchill.

Halifax, N.S.—Plans have been prepared by S. P. Dumaresq, architect, for erection of new Baptist church, and tenders will be called this winter. Pastor, Mr. Boyer.

Halifax, N.S.—Foundation work for four new school buildings in the north end, St. Joseph's, Richmond, Bloomfield and St. Patrick's, is now going on. The Nova Scotia Construction Co. has the contract for erection of the Richmond school, W. E. Landry the Bloomfield and the McDonald Construction Co. the other two. Brick and reinforced concrete construction.

Hamilton, Ont.—Board of Education proposes to erect a new school on Concession St.

Hamilton, Ont.—Dominon Canners, Ltd., have purchased a factory site on Gilkinson St.

Hamilton, Ont.—Hon. H. C. Nixon, Provincial Secretary, has approved of an expenditure of $50,000 for nurses' home.

Hamilton, Ont.—A permit for an extensive four-story addition to the factory of the B. Greening Wire Co., Napier St., has been issued to W. H. Yates. Estimated cost, $40,000.

Hamilton, Ont.—The application of the Board of Education for permission to expend $15,000 for a school site on Mount Hamilton was approved by Board of Control and sent on to the city council.

Hamilton, Ont.—Tenders will be received until 12 o'clock noon, December 6th, for erection of store, office and apartment building, corner Barton and Ottawa Sts., for East End Markets, Ltd. Plans and specifications may be seen at the office of F. W. Warren, Bank of Hamilton Building, Hamilton.

Kitchener, Ont.—Excavation has started for the erection of a new gas plant.

Kitchener, Ont.—Movement is on foot for establishment of Y.M.C.A. here and erection of building.

Lethbridge, Alta.—A movement is on foot by Arthur Baalim, of this city, for the erection of a large hotel here.

London, Ont.—Campaign will be launched by I.O.D.E. for erection of Sick Children's Hospital. Secretary, Mrs. F. J. Grenaway.

London, Ont.—The property at 241-243 Queen's Ave., has been purchased by Dr. L. S. Holmes, who plans to remodel it for a modern office building. Tenders are being received. Approximate cost, $20,000.

Montreal, Que.—A campaign will be launched to raise funds for rebuilding Laval University.

Nelson, B.C.—The Consolidated Mining and Smelting Co. of Canada will at once rebuild copper mill recently destroyed by fire, which entailed a loss of between $8,000 and $10,000.

Niagara Falls, Ont.—Under the name of the Niagara Wire Weaving Co., the Lindsay Wire Weaving Co., of Cleveland, Ohio, is spending $220,000 on the erection of a plant here.

Ottawa, Ont.—The members of the King Edward Ave. Synagogue have decided to enlarge their building. Architect, Alan Horwood.

Ottawa, Ont.—Architect W. E. Noffke, appointed by the Police Commission to investigate conditions at the local police stations, recommends that the city erect an imposing structure, to be used as a municipal centre and house all local offices, such as the city hall, a fire station and a memorial hall. He also recommended that minor improvements be made to the present building in the meantime. Mr. Noffke's plans call for a building to be worth $2,500,000.

Prince Rupert, B.C.—A new school is to be erected here.

Quebec, Que.—Gosselin Shoe Co. will erect factory on St. Leon St. and Bigaouette Ave. Approximate cost, $40,000.

Quebec, Que.—Permits granted to the Brown, Rochette Co., Ltd., for alterations to their plant on Nelson St., to cost about $3,000, and to Legace and Lepinay for alterations and repairs to their establishment at a cost of $13,000.

Regina, Sask.—Saskatchewan Co-operative Elevator Co. is considering the erection of a large flour mill.

Regina, Sask.—A warehouse building, costing $175,000, will be erected here by Wood, Vallance, Ltd., of Hamilton, Winnipeg and Calgary, provided the city council is prepared to sell certain lots for 65 per cent. of the assessed valuation.

Saanich, B.C.—School trustees considering erection of high school.

Sarnia, Ont.—John Filsinger is planning the erection of a three-story brick building on Christina St.

Sarnia, Ont.—By-law granting aid to the General Hospital for the erection of an addition and the installation of equipment was provisionally passed by city council.

Smith's Falls, Ont.—The Canadian Cooperage Manufacturing Co. will erect a mill.

Sperling, B.C.—The Sperling Improvement and Development Association plan erection of a public hall. President, David Harris.

Stratford, Ont.—Ratepayers will vote on by-law to raise $25,000 for establishment of soldiers' clubhouse.

Strathroy, Ont.—The Strathroy curlers have decided to remodel their rink.

St. John, N.B.—The Eastern Canada Air Lines, Ltd., may erect an aerodrome here next year.

St. John, N.B.—It is stated that negotiations are under way here for the erection next spring of a first-class hotel. Approximate cost, $500,000.

St. John, N.B.—Ross & McDonald, architects, Ottawa, in a report made on the old court house and proposed new site for a civic centre, recommend that a court house and city building be established at the corner of King and Sydney, a fire station be built at the corner of King and Carmarthen and that a garage and stables be erected at the corner of Leinster and Carmarthen. They also recommend the widening of King St.

St. Thomas, Ont.—City council may erect a municipal aerodrome.

St. Thomas, Ont.—A. J. Voege is building an addition to his factory.

Sudbury, Ont.—High School Board plans erection of new school building. Approximate cost, $200,000.

Sydney, N.S.—An expenditure of over a half million dollars is to be made by the Dominion government on the construction of new terminals for this port. Preliminary work will start at once.

Tavistock, Ont.—It is rumored that the Tavistock Milling Co. purpose enlarging their mill.

Toronto, Ont.—Fairbank branch, G.W.V.A., will erect a clubhouse.

Toronto, Ont.—The Lake Shore branch, G.W.V.A., plan erection of memorial hall and clubhouse.

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Toronto, Ont.—Plans being prepared by City Architect's department for erection of Reception Hospital.

Toronto, Ont.—Beaches branch of the G.W.V.A. will erect a clubhouse at Kenilworth Ave. and Queen St.

Toronto, Ont.—Permit issued to Imperial Extract Co. for alteration and addition, Matilda Ave., to cost $2,000.

Toronto, Ont.—It is rumored that the Queen's Hotel property has been purchased by the Canadian National Ry.

Toronto, Ont.—A movement is on foot for erection of two four-roomed schools in S.S. No. 7, Woodbine Heights.

Toronto, Ont.—School Board estimates the amount required for erection of public schools in 1920 at $2,000,000.

Toronto, Ont.—Provincial government will urge Federal government to construct a government-owned grain elevator here.

Toronto, Ont.—The erection of a new building for Jarvis St. Collegiate Institute is being urged on Board of Education.

Toronto, Ont.—The Royal Astronomical Society will erect a scientific observatory on the west side of Bathurst St., north of St. Clair Ave.

Toronto, Ont.—Perimt issued to Board of Education for addition to Close Ave. Collegiate Institute, to cost $60,000, and to F. G. Soper for addition to factory, 200 Laughton Ave., cost, $66,000.

Toronto, Ont.—Plans for the new Norway School, corner of Kingston Rd. and Heyworth Cres., which is to cost approximately $86,000, have been approved by the City Architect's department.

Toronto, Ont.—Permit issued to the Cowan Co. for 7-seven story brick and reinforced concrete factory, 72-74 Sterling Rd., $250,000, and to the Toronto Club for addition to clubhouse, York St., $5,000.

Toronto, Ont.—Contract let to J. B. Nicholson, Ltd., Hamilton, for 600-ton circular reinforced concrete coal-handling plant, to be constructed for F. R. Pember, corner Jones Ave. and Grand Trunk Ry.

Toronto, Ont.—Since November 1st permits for buildings estimated to cost $1,600,000 have been issued by the City Architect's Department. The permits include $206,000 for schools, $190,000 for stores, $170,000 for garages, $236,000 for warehouses.

Toronto, Ont.—A. D. McBride has organized an Auto Service Co. for the purpose of building a fireproof parking station and storage garage on the south-west corner of Richmond and Sheppard Sts. Approximate cost of site and building, $600,000. Mr. McBride may also erect a parking and storage station building east of Yonge St. and two more stations convenient to residential districts.

Toronto, Ont.—Baldwin's, Ltd., of Swansea, England, who have taken over the plant of the British Forgings, Ltd., will commence the erection of two buildings immediately, according to Business Agent Bowering, of the Structural Iron Workers' Union. He also expects that the steel work of the Pantages and Loew's Theatres will be commenced within the next ten days.

Vancouver, B.C.—The Regal Films, Ltd., propose to erect a $500,000 theatre on Seymour St.

Vancouver, B.C.—Vancouver Gas Co. plans extension of its plant. General manager, George Kidd.

Vancouver, B.C.—Howard & Davis have taken out a permit for the construction of a $10,000 tire service station building at 1301-1303 Granville St.

Vancouver, B.C.—Officials of the Soldiers' Civil Re-establishment are preparing plans for the reconstruction of and additions to the Shaughnessy hospital.

Vancouver, B.C.—The Marconi Wireless Telegraph Co. of Canada, Montreal, will build a powerful radio depot in this vicinity. Estimated cost, $2,000,000.

Vancouver, B.C.—City council granted permission to the Regal Films Co. to build an overhead bridge across the lane between Granville and Seymour Streets, in connection with the theatre which they will erect.

Vancouver, B.C.—The Allen Theatres, Inc., who are to build a $300,000 theatre at the corner of Seymour and Georgia Sts. early next year, have applied for permission to build an arcade over the lane abutting on the rear of their site.

Vancouver, B.C.—A permit covering the construction of a new saw factory on Industrial Island has been taken out by T. H. Tait, manager of the Ætna Saw Works. Estimated cost, $4,000. The Canadian Pacific Ry. Co. has taken out a permit for alterations to the interior of the cold storage building at the foot of Gore Ave. Estimated cost, $4,000.

Walkerville, Ont.—Building permits for the present year to date total $1,808,000. In addition to this, there is building going on at the present time to the amount of about $100,000 for which permits have not been issued pending the completion of some of the plans. It is expected that the total figures for the year will reach well over $2,000,000.

West Toronto, Ont.—The General Mercer branch, G.W.V.A., plan erection of clubhouse.

Whitby, Ont.—A movement on foot here to erect a memorial hospital for Ontario county was presented to the council. Estimated cost, $25,000. Address, Major Blow.

Windsor, Ont.—The British-American Brewing Co. will erect a $125,000 extension to their plant.

Windsor, Ont.—Board of Education asked city council for an appropriation for the purchase of a school site on Tecumseh Rd.

Windsor, Ont.—Work on erection of new Allen theatre on Ouellette Ave. will start at once. Architect, C. Howard Crane, Detroit.

Windsor, Ont.—Plans have been prepared by J. P. Thomson, architect, Walkerville, Ont., for erection at Pelissier Ave. and Maiden Lane of memorial hall for Border Cities branch, G.W.V.A.

Windsor, Ont.—Excavation work has started on new departmental store to be erected by the C. H. Smith Co. on Ouellette Ave. Building will be four stories, and of structural steel, hollow tile and brick construction. Work will be under direction of R. Westcott Construction Co. Architect, A. H. McPhail, Windsor.

Winnipeg, Man.—The Elgin Gas Motor, of Elgin, Ill., is erecting a three-story factory here.

Winnipeg, Man.—A theatre, costing $600,000, will be erected here next March. Address, S. E. Richardson.

Woodstock, Ont.—Ratepayers passed by-laws granting concessions to the Brunswick Canadian Products Co. and the Warren Pipe Organ Co., who will now erect large plants here.

York Tp., Ont.—Township council plans erection of fire hall. Clerk, W. A. Clarke, 40 Jarvis St., Toronto.

MISCELLANEOUS

Brokenhead, Man.—A scheme is under way by the Dominion government for the deepening of the Brokenhead River.

Edmonton, Alta.—Tenders addressed to N. L. Harvey, Deputy Minister of Railways and Telephones, Edmonton, Alta., will be received up to 12 o'clock noon, December 10th, 1919, for the supply of the following telephone poles: Cedar poles, 30 ft. long, 7-in. top, 6,000; cedar poles, 30 ft. long, 6-in top, 6,000; cedar poles, 25 ft. long, 5-in. top, 16,000; cedar poles 25 ft. long, 5-in. top, 20,000; cedar poles, 20 ft. long, 5-in top, 76,000; tamarack poles, 25 ft. long, 5-in. top, 27,000; tamarack poles, 20 ft. long, 5-in. top, 76,000. Specifications can be obtained on application to the Engineer and Plant Superintendent's office at Edmonton.

Fort William, Ont.—It is reported that the Canadian Car and Foundry Co. has decided to build ships as one of its chief industries.

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27 McGill College Avenue **MONTREAL, CANADA**

Galt, Ont.—New plans will be prepared by the Parks Commissioner for erection of fireproof grandstand of concrete and steel construction at Dickson Park, tenders received being too high, the lowest of which was for $29,400. while the ratepayers voted only $15,000 for the stand.

Hamilton, Ont.—City Council will submit a by-law to the ratepayers authorizing the expenditure of $5,000 for motor equipment for the fire department.

Hamilton, Ont.—The following are among the by-laws which the city council resolved to submit to the electors on January 1st: By-law for borrowing $72,000 for the purchase of fire protection appliances; $50,000, to be used in the construction of the proposed mountain highways and improvements; $850,000 for the construction of the first unit of a storm overflow sewer system; $150,000 for the establishment and construction of a civic athletic field on the Scott Park lands and for improvements to Victoria Park, North End Park, Mountain Face and Gage Park. Hydro radial by-law will also be submitted.

Ottawa, Ont.—Joint stock companies incorporated last week include the following: Fairchild Engineering Co., Ltd., Brantford, $50,000; W. H. Yates Construction Co., Ltd., Hamilton, $500,000; St. Maurice Power Co., Ltd., Montreal, $6,500,000.

Port Arthur, Ont.—By-laws will be submitted to electors in January to authorize extension of street railway at approximate cost of $102,000, extension of municipal telephone system at cost of $1,000, and the building of two miles of road, at a cost of $21,000, to the site of the proposed mills of the Great Lakes Pulp and Paper Co.

Raymond, Alta.—Control and operation of municipal waterworks and lighting systems may be taken over by the Ellison Milling Co.

Scotch Cove, N.S.—Contract let to A. W. Girroir and W F. MacKinnon, of Antigonish, N.S., for extension to breakwater.

Toronto, Ont.—York county council is considering following improvements to Industrial Home: Water supply system, at cost of $9,000; heating system, $7,000; rewiring, $2,500, and standpipe for fire protection purposes, $6,000.

Toronto, Ont.—Board of Control divided contract for 6,000 feet of fire hose as follows: 2,000 feet each to the Gutta Percha and Rubber, Ltd., and Dunlop Tire and Rubber Goods Co. and 1,000 feet each to the Goodyear Tire and Rubber Co. of Canada, Ltd., and the Canadian Consolidated Rubber Co.

Vancouver, B.C.—Plans for harbor work here are now being prepared by the Dominion government, and as soon as they are ready, tenders will be called for. Minister of Marine and Fisheries, Hon. C. C. Ballantyne, Ottawa.

Victoria, B.C.—Provincial government will at once call for tenders on the big Sumas dyking project. Approximate cost, $1,500,000. Minister of Agriculture, Hon. Mr. Barrow.

Winnipeg, Man.—A triangle, comprising 800,000 acres of land lying between the Saskatchewan River, the Carrot River and the Sepanok Channel, which, for an expenditure of about $1,500,000, could be reclaimed, will be brought to the attention of the Minister of the Interior.

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Plans, specifications and all further information may be obtained on application to M. D. Cadwell, Superintendent of Utilities, City Hall, North Battleford, Sask.

ROBERT FARQUHARSON, City Clerk.
The City Hall, North Battleford, Sask.,
November 18th, 1919. 383

Time for acceptance of above tenders has been extended to 5 p.m., Saturday, December 20th, 1919.

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The Canadian Engineer

A Weekly Paper for Civil Engineers and Contractors

Present Status of the Sewage Disposal Problem

Efforts to Recover Valuable Nitrogenous Contents of Sewage Made Difficult by Colloidal Nature of Activated Sludge--Cities May Have to Dissolve and Oxidize as Much of Organic Material as Possible, Turning out Smaller Quantity of Stable Residue and Making No Attempt at Conservation

By Dr. GEORGE G. NASMITH
Director of Laboratories, Department of Public Health, Toronto

WHEN an interested person with the solution of some sewage disposal problem in mind begins to make a survey of the existing installations, he is soon struck with the fact that there appears to be no perfect sewage disposal plant in existence. Some will show one good feature, some another, but after a thorough investigation the investigator will be convinced that the most notable feature about the majority of sewage disposal plants is the apparent failure to achieve the object aimed at, or some marked nuisance in connection with the operation of the plants.

It seems to me that it has been the lack of appreciation by engineers of the principles involved in sewage disposal that has chiefly been responsible for the large number of offensive sewage disposal plants in this and other countries.

One factor frequently responsible for the improper operating of sewage disposal plants has been the failure of engineers to take into consideration the large amount of silt and detritus brought down in sewage, and to provide detritus chambers of sufficient capacity. As a result silt passes over into the sedimentation tanks proper and settles out in the form of compact deposits which prevent proper sludging of the tanks. The consequence is that decomposition of the sludge sets in, large quantities of offensive gases are given off, both in the tanks and during the sludging process, and a nuisance is created.

In other cases incomplete sewage disposal systems have been installed. These frequently consist of a system of screens, grit chambers and sedimentation tanks, the effluent being allowed to flow into the nearest stream or lake. If this effluent flows into a body of water too small to handle it, all the oxygen is absorbed from the water, the organic matter in the effluent settles out, anærobic action takes place, and again a nuisance is created, to say nothing of the possible danger from contaminated water supplies.

Sludge Treatment a Nuisance

Or again, when sludge is to be treated, a nuisance is almost certain to result, because sewage sludge cannot be rapidly dewatered or dug into ground and can only be kept from undergoing offensive bacterial putrefaction with the greatest difficulty.

In many cases where nuisances have arisen, the fault has not been that of the engineer, who originally designed the plant with a full knowledge of the subject of sewage disposal held at the time of its construction. Sometimes well-designed plants have been allowed to become public nuisances through mismanagement. In other cases the growth of the municipality has resulted in the plant being overloaded, with no attempt to remedy the trouble by properly extending the system.

All of these conditions have come within the experience of anyone who has studied the problem of sewage disposal at all extensively. In England, the writer has seen numerous small installations consisting of sedimentation tanks and bacteria beds which appear to be carried on with a comparatively negligible amount of nuisance. It is only a question of degree, however. If these small installations were increased to ten or twenty times their capacity, the negligible nuisance would become marked.

At Salford I saw the original activated sludge plant operating without the slightest odor upon a most objectionable-looking sewage containing large quantities of dye products and explosive manufacturing wastes. At Devizes I examined a very excellent installation of sedimentation tanks and trickling filters. This system was considered to be one of the very finest examples of its kind in England; there was little odor and the whole process was carried on in the open air.

Operation Is Important Factor

Whether there is a nuisance or not at any disposal works depends on the operation of the plant as well as on the installation, and as plenty of labor can usually be obtained in England, the plants there are, as a rule, well looked after.

In America it has been possible for engineers to install many sewage disposal plants that looked well on paper, because the local authorities did not know enough about the problem to tell whether the plans were suitable or not, and there was no central authority, or referee, with sufficient minute knowledge of the subject to whom the plans of the proposed installation could be submitted. This central, independent expert authority, or referee, has been established in Ontario and other provinces in the person of the sanitary engineer of the Provincial Board of Health, instead of the Board itself, as was the case in Ontario at one time.

The disposal of sewage in its various stages is absolutely dependent upon bacterial action. Bacteria are the agents which are employed to carry on the series of destructive processes which finally convert the organic matter present in sewage into inert inorganic salts and a humus-like residue which can no longer undergo active putrefaction. Two classes of bacteria may be employed, according to the result wished for: Anærobic and ærobic.

The anærobic type are hydrolytic organisms, and as a rule split up complicated organic materials into simpler organic materials, frequently with the production of hydrogen sulphide and other offensive gases.

Aerobic bacteria, on the other hand, tend to directly oxidize or burn up organic compounds, or their split products, into inoffensive, inorganic stable compounds, such as carbon dioxide, nitrates, sulphates and other salts. The final result of anærobic and ærobic action combined, which is presumably the general rule, is a stable organic residue called "humus."

Because of the nuisance which results from the ordinary anærobic or hydrolytic fermentation of sewage, the tendency has been to discard this process and employ ærobic methods wherever it is possible to do so. It is a simple matter to obtain a clear, non-putrescible effluent by passing the sedimented sewage over trickling filters, or by means of the activated sludge process, without any nuisance arising. The inoffensive treatment of sludge, whether from plain sedimentation tanks or from activated sludge process, has until recently proved very difficult, because sludge is putrescible and the only method yet known of digesting it to a non-putrescible residue is by the anærobic process.

What Treatment Must Involve

The treatment of sewage by modern methods must involve:—

1. The thorough screening of coarse material from the sewage.

2. The complete separation of grit and other readily sedimented inorganic matter in suitable grit chambers before the sewage passes over into the sedimentation tanks proper.

3. The complete separation of all organic material capable of being sedimented in special tanks.

4. The treatment of the effluent from the sedimentation tank on bacteria beds to form a clear, non-putrescible effluent.

5. The treatment of the sludge without nuisance to yield a non-putrescible, easily handled residue.

Of these phases, the third and fourth may be combined, as they are in the activated sludge process, while the treatment of the sewage by efficient screening and grit chambers is absolutely essential as a preliminary to any disposal system.

The object of the chemical engineer, or sanitarian, is to convert all the contained organic matter in sewage into inorganic matter, or something which is no longer putrescible. To be ideal, there should be no nuisance connected with any part of the process, from beginning to end—an ideal which only now we are beginning to believe possible of accomplishment.

The activated sludge process would have brought us pretty close to the ideal solution were it not for the fact that activated sludge is colloidal in character, will not readily separate from its water content, and is putrescible. But because of this drawback the most difficult task remains unsolved, and we must seek elsewhere for the solution of the sludge problem. According to our experience in Toronto, continuous aeration of activated sludge for two weeks will not produce a stable residue; it still has to undergo anærobic action before it can become a stable, inoffensive material.

Public Resents Stream Pollution

With the increase in knowledge on the part of the general public on questions of public health, there is a growing objection to the pollution of water-courses by sewage, not only because of the possible danger of typhoid fever and other intestinal diseases, but also from the aesthetic standpoint.

Of course, there are occasions, during periods of heavy rainfall and storms, when the sewage of any municipality, unless it has a special system of sanitary sewers, will have to be by-passed into the nearest stream or lake. This occasional pollution is not what people object to, but rather to the principle which approves of the deliberate fouling of our water supplies and their subsequent purification.

The dwellers on streams below towns are more and more resenting the conversion of those formerly limpid streams into foul and turbid water-courses because some tanner, manufacturer or town upstream throws waste products into them. And, because of this growing hostility to the interference of what are felt to be the reasonable riparian rights of property owners by the deliberate pollution of streams by irresponsible parties, it is becoming less easy for manufacturers and towns to solve their disposal problems by the simple process of carrying a pipe line to the nearest watercourse and letting their wastes empty into it.

The ideal method of sewage disposal, sought for so long and so patiently by sanitarians, is actually now appearing in sight. Gradually we have learned the basic principles involved in the disposal of sewage, and, because these are purely biological in character and could not be learned through laboratory experiments, but only from deductions based upon experiments on a very large practical scale, it has taken a long time to establish them.

What would constitute an ideal method of sewage disposal? To the writer it would mean the carrying on of the whole process without any nuisance whatever, at the minimum cost and with the production of a non-pathogenic and non-putrescible effluent which could be turned with safety into the nearest water-course. The entire process, moreover, should, if possible, be carried out in tanks of simple and economical design that would not involve an elaborate pumping plant or the construction of bacteria beds.

Leaving the small septic tank out of the question, every system of sewage disposal of any scale involves the separation of suspended material from the sewage, and treatment of the effluent and sludge independently.

Effluent Stable, Sludge Putrescible

It has hitherto proved impossible to digest sewage in tanks in such a way as to yield both a stable effluent and a non-putrescible sludge. The closest we have come to this is in the activated sludge process, where a clear, stable effluent is produced, as well as a partially stabilized sludge. If the activated sludge produced was a perfectly stable material which could be readily dewatered, we would have an ideal method, but the sludge from an activated tank is still colloidal and clings to its contained water with the greatest obstinacy; consequently, it cannot be readily dried out on any kind of filter beds, though apparently about 40% of its contained water may be readily removed by centrifugal action.

The prevailing methods of sewage disposal in America include the activated sludge system, plain sedimentation tanks alone or in combination with trickling filters, the double-tank system of Travis or Imhof, and sludge digestion tanks. The ordinary large septic or hydrolytic tank has to a large extent been superseded on account of the nuisance with which its operation is attended, and the various types of contact beds, which were common in England, but are now out of date, never gained a foothold here.

The small septic tank for household use is a very valuable method, because it is automatic, liquefies solids, and, since the whole process is carried on underground, is inoffensive. The liquefied effluent from the small underground septic tank flushes periodically into a system of underground tiles placed not far below the surface of the ground; from this tile system it soaks into the soil, and any organic matter present is destroyed by bacterial action, while any gases are absorbed by the soil.

An advance on the large septic tank was the double-chambered tank of Travis and Imhof. These types permit the sludge which settles out from the upper tank to fall through into the lower tank, where it undergoes digestion independent of the tank above it. Sometimes this kind of digestion is satisfactory and does not create bad odors; at other times the digesting sludge in the lower tank boils up into the second tank and is very offensive. Consequently, many of these double-chambered tanks have been abandoned. One very valuable fact was established by the process, namely, that it is possible under certain conditions to digest sludge anærobically without offense.

Sludge Valuable as Fertilizer

The activated sludge process, which is excellent in that it is carried out in tanks, removes all colloidal matter in suspension and turns out an excellent, clean and non-putrescible effluent, is also essentially a biological process. It depends, however, on an ærobic flora, quite different in character from that which operates in the anærobic systems mentioned above. The process produces a sludge which quickly separates from the sewage, leaving a clear and almost colorless supernatant water. Sludge presses or centrifugal action

will reduce the water content of activated sludge to about 60%.

It is interesting to note that in the further drying of activated sludge by artificial means, objectionable gases are given off which, unless carefully looked after, may create a local nuisance.

The fertilizer value of activated sludge is high, as both Bartow and Hatfield* and G. P. McKay and the writer† have pointed out. Mr. McKay and the writer have shown in actual outdoor plot experiments, subsequently confirmed by greenhouse plot experiments, that activated sludge, compared with barnyard manure, will produce yields of vegetables of extraordinary size. Results showed increases in the outdoor crop yield amounting from 100% in the case of lettuce to 290% in tomatoes, and even 550% in the case of Weatherfield onions. The results under glass, which have not yet been published, are equally remarkable.

Combination May Solve Problem

Owing to the difficulty and cost of dewatering, the trouble involved in the drying process, and certain other objections, the activated sludge method is not the last word on sewage disposal. It looks as though the solution of the sludge problem will depend upon a combination of the activated sludge process with sludge digestion or plain sedimentation tanks followed by trickling filters and sludge digestion. The latter will be controlled under definite conditions which are now fairly well established, and will be operated as a distinctly biological problem.

The practice to be followed will of necessity in small installations be more or less empirical, since expert assistants will not be available. This defect, of course, might be overcome by having the smaller sewage disposal plants placed under the indirect supervision of some qualified expert, who could keep them under proper working conditions and advise as to changes in methods of operation, additions to or modifications of the plant, from time to time as needed.

The principles underlying the activated sludge process and the trickling filter may seem to be quite different. As a matter of fact, they are identical. In the trickling filter some medium, whether it be stone or brush as in the Leaside plant, is employed, over which the sewage slowly trickles. The stone or wood after a time becomes covered with a slimy material which has the property of absorbing solids, colloidal material and other inorganic compounds from the thin sewage films flowing over it, and of converting this absorbed matter, through biological oxidation processes, into inert, non-putrescible, inorganic matter.

In the activated sludge process this same kind of slimy material which forms on the surface of a trickling filter is gradually produced by bubbling air through sewage held in tanks. When fresh sewage is agitated for some hours with this activated sludge by streams of fine air bubbles, the organic matter in the sewage is attracted to the activated sludge just as it was attracted to the slimy film on the stone or wood trickling filter, and is so altered that only inorganic, non-putrescible materials pass over in the clarified effluent.

Different Methods, Same Principle

In the one case the sewage circulates through the air over an activated biological medium; in the second case the activated biological medium is circulated through the sewage in association with large quantities of air bubbles. The combination of ærobic bacterial agent and air is identical in both methods. That this biological agent is identical in both cases was proved by the writer, who started a small activated sludge tank with ripened sludge collected from a lath trickling filter. The nitrification and clarification, which usually takes several weeks to develop, began at once, proving that the biological medium was one and the same, and that the processes were identical.

In the opinion of the writer, the complete solution of the sewage disposal problem will come about finally through a combination of the activated sludge process, or trickling filters, with sludge digestion. It may be that the activated sludge process will be the preliminary installation, followed by digestion tanks; or it may be that actual sewage digestion will be the first installation.

Brush Affords Greater Capacity

In one of the common types of sewage disposal plants, sedimentation tanks remove the larger part of the suspended organic matter, and the effluent is treated on trickling filters or oxidizing beds. These may be of stone, clinkers, brush or other material, and the general rate of treatment has been from two or two-and-a-half million gallons of sewage per acre per day on the older form, to seven million gallons per acre per day on the newer brush filter.

Where plenty of fall is available, trickling filters, particularly in small installations, will frequently be considered preferable to the activated sludge method. At the Leaside, or North Toronto, sewage disposal plant, one of the trickling filter beds, composed of stone, was at my suggestion replaced some six years ago with bundles of brush tightly packed together. Operating side by side for six years, the other old stone filters have treated from two to two-and-a-half million gallons of sewage per acre per day, while the brush filter has averaged six-and-a-half million gallons per acre per day.

The brush filter was simply the logical conclusion of experiments carefully conducted by us at our experimental plant to determine the greatest amount of filter medium which, allowing free access of air, could be packed in six feet of filter bed. This method, which was patented at the time, is free to those who wish to use it, and, since it is cheap and will reduce the amount of filter area required to one-third, there should be many places where its use should prove desirable.

It may be stated here that the brush to date shows absolutely no signs of decay, and is as sound as it was six years ago when placed in situ. With this method, of course, the sludge problem has still to be dealt with.

Can Digest Sludge Inoffensively

Though it has not been possible to digest sewage anærobically and obtain a non-putrescible residue without offense, it has proved possible to digest sludge without creating a nuisance. Watson, of Birmingham, has shown* that sewage sludge can be thoroughly digested on a huge scale without causing a nuisance. At Birmingham the fresh sludge from ordinary sedimentation tanks is drawn off and pumped into digestion tanks, receiving before it enters these tanks one-fourth its volume of old, thoroughly ripened sludge. This seeds it with the proper bacterial flora, and, provided the temperature is right, digestion will progress to a conclusion without the production of foul odors. At the end of four months the sludge is thoroughly digested, is no longer putrescible, is reduced in quantity and is readily drained on ordinary drying beds.

The action which occurs in the Birmingham sludge tanks is apparently the same as that which occurs in a properly operated Imhof tank. Dr. Carl Imhof, while on a visit to Toronto in 1913, told us that it was quite feasible to digest sewage sludge without offense. He advocated the mixing of one part of Emscher (Imhof) sludge with one part of fresh sludge, and stated that a ripened sludge would be produced in one week. One part of this could then be mixed with an equal volume of fresh sludge, and so on, ad infinitum. The Emscher sludge itself takes from nine to twelve months to prepare.

Those attempting to solve the sludge problem have in mind two definite objectives. In the first case, an attempt is being made to save the tremendous waste of valuable nitrogenous matter present in sewage, and retain it in the

*See Journal of Industrial and Engineering Chemistry, Vol. 8, No. 1, January, 1916.

†See article, "Fertilizer Value of Activated Sludge," by G. G. Nasmith and G. P. McKay, in *The Canadian Engineer*, May 2nd, 1918, page 377.

*See "The Utilization of Sewage Sludge," by John D. Watson, in *The Canadian Engineer*, October 30th, 1919, page 420.

form of fertilizer. The success of the activated sludge process would seem largely to depend upon the fact that a revenue is expected from the dried activated sludge. From the standpoint of conservation alone, particularly if a satisfactory and economical process is found for dewatering the sludge, there is everything to be said for the process, and, particularly in cities which do not possess tanneries, there are no objections to the use of this material as fertilizer. On the other hand, it is doubtful whether the activated process will be popular with small municipalities because of the expert care necessary in operating the plant. In the second case the tendency is to first dissolve and then thoroughly oxidize as much of the organic material in the sewage as possible, and turn out the smallest possible quantity of a stable residue.

In the latter case no attempt would be made to obtain any income, and the process would be worked out along lines of operation that would be, so far as possible, automatic.

Like many others, we were in favor of the conservation idea, and the saving of as much as possible of the nitrogen and other fertilizer ingredients in sewage by the activated sludge process, until our work and that done elsewhere convinced us of the as yet unsolved difficulty of rapidly and economically drying the sludge.

Even if the material could be produced economically and without nuisance, it is realized that the sale of same and consequently the economical operation of the plant would be a purely business proposition, in competition with established industries, and, in case of success, with other municipalities.

For these reasons the writer has come to the conclusion that the second process will be the one generally adopted. It appears as though the final solution of the sewage disposal problem will come about eventually through a combination of the activated sludge process or trickling filters in combination with sludge digestion tanks. It may be that the activated sludge process will be the preliminary installation, followed by digestion tanks. It may be that actual sewage digestion tanks will be the first installation, followed by the activated sludge process. Certain preliminary work, which has been carried on by us for a year, shows very promising results, and it is hoped that in the near future we will have information and data for publication as to the results obtained.

Letter to the Editor

COST-PLUS-FIXED-FEE CONTRACT

Sir,—In your issue of September 11th, the article by A. E. Wells, entitled "Cost-Plus-Fixed-Fee Contract," makes it quite clear that the method is very advantageous to the contractor who does the work.

Will you permit me to say a few words concerning what cost-plus-fixed-fee means to owners, and incidentally to touch upon the question of what it means to the small-fry contractors who are ambitious to expand?

This is what it means to the owners:—

First.—Placing themselves absolutely in the power of the contractor, who can make the work cost as much as he likes.

Second.—Placing themselves at the mercy of all the workmen on the job; for the latter cannot be induced to labor faithfully when they know that the "boss" will lose nothing by their idleness, no matter how honest may be the intentions of the contractor about keeping down the expense.

It is useless to deny the correctness of these two statements, for anyone with common sense must acknowledge it. While it is practicable to improve this method materially for the owner by substituting a sliding-scale fee for the fixed fee, even this will not protect him effectively, unless there be something in the nature of a penalty for the contractor, either to prevent him from neglecting to push the work or to make him pay for his negligence. A limit of total cost which can be increased or reduced properly, in order to provide for an increase or decrease in the estimated total quantities of materials, will prevent the owner from being excessively robbed, and still will give the contractor every opportunity to come out whole in the case of all but extraordinary hard-luck.

Such a method I expounded in a paper recently published by "Contracting," of Chicago.

[NOTE.—This article is reprinted for the reader's convenience, on page 527 of this issue of *The Canadian Engineer*. —EDITOR.]

It outlines an ideal, just, scientific and perfectly feasible method of contract-letting and profit-sharing,—one that is fair to both parties by making the owner and the contractor partners on the job, thus tending towards harmony and towards the utilization of every practicable method of legitimately keeping down the cost.

My scheme could be enlarged slightly in the interest of both the contractor and the owner by arranging in the specifications for a modification of the limiting cost by a ratio based upon the ratio of general average rise or fall of workmen's wages during the progress of the work. It would not be difficult to draft such a clause upon truly equitable lines.

Again, my method could be amended in the interests of labor by arranging that the contractor and the owner, immediately after the final settlement, shall each turn back a certain percentage of his declared profit (say, 20%) into a fund, which fund shall be divided among all the employees who have stayed on the work until its completion or until their services were no longer needed, the amount of each individual's share of the bonus being directly proportional to his total salary or wages in comparison with the sum of all salaries and wages. Such an arrangement would tend to make everyone on the job do his utmost to keep down the cost and to work faithfully and to the best of his ability.

And now a word as to how cost-plus-fixed-fee affects the small-fry contractors. Is it not evident that it will militate towards cutting them out of bidding? When an owner is willing to let any work on a cost-plus basis, he naturally wants to award it to a large contractor of means who has an established reputation for fairness and efficiency. That would practically mean letting all contract-work without competition,—and contractors as a body would object seriously to any such procedure. It is true that the owner might call for competitive bids by letting each bidder name a lump sum for his fixed fee, and awarding the contract to the competitor who names the lowest figure; but the adoption of such a method would often result in serious trouble, delay and expense.

It would be a great benefit if there were evolved and adopted, with the least possible delay, a method of contract-letting and profit-sharing that should always prove satisfactory to both parties to the agreement. By having it first discussed thoroughly in the papers, then seriously considered by a small committee representing the various organizations of engineers, architects, contractors and bankers, so as to determine tentatively some standard method for formal approval by each of the said organizations, the result desired could be attained. The benefits to be derived by the adoption of such a standard are far beyond the ability of anyone to predict.

J. A. L. WADDELL,
Consulting Engineer.

Kansas City, Mo., December 1st, 1919.

Applications are being invited by W. Foran, secretary Civil Service Commission of Canada, Ottawa, Ont., to fill the following vacancies: Instructor in mathematics, Royal Military College, Kingston, $1,800 per annum; engineering clerk, Topographical Surveys Branch, Department of Interior, $1,260 per annum; inspector of gas and electricity at St. John, N.B., $1,260 per annum. The last mentioned position is open only to residents of the province of New Brunswick.

SASKATCHEWAN'S PUBLIC FERRY SERVICE

By G. A. Palmer
Department of Highways, Regina, Sask.

THERE are 42 ferry crossings in Saskatchewan; all of these are important links in the main road system of that province. The ferries are operated by the Department of Highways and are free during daylight hours; they are accessible after dark, but a toll is then charged by the ferrymen.

In the pre-Rebellion days, a few scows were operated by the Indians and half-breeds at three or four of the main crossings, and under the government of the North-West Territories these crossings were brought under recognition and the ferrymen received licenses to operate at a fixed rate of tolls. When the provincial government assumed control in 1905, this system was superseded by establishing

Fig. 1—Standard Saskatchewan Ferry Scow

paid ferrymen at all new crossings, the old licenses being gradually eliminated, and in 1912 a system of free ferriage was established, the ferry service was unified and the scows and tackle of all crossings were brought to a government standard.

The growth of the ferry traffic from an occasional rancher's rig or pioneer's cart to the present-day heavily loaded grain tank, drawn by six horses or moved by motor power, and automobile traffic, reflects the short and rapid history of the development of the agricultural and cattle industry in Saskatchewan.

A comparison of the units of traffic carried by this ferry service for the last three years is interesting: —

Year 1916	.....	127,677
" 1917	.....	465,822 "
" 1918	.....	604,027 "

Fig. 2—South Saskatchewan River

Also the comparison between the decline of the wagon traffic and the increase of the automobile traffic:—

		Wagons.	Automobiles.
Year 1916	.....	122,677	25,738
" 1917	.....	107,270	60,386
" 1918	.....	111,770	103,928

There are required for Saskatchewan's ferry service 61 standard scows and 61 rowboats; 102,000 ft. of 1¼-in. steel

Fig. 3—Ice Makes Landing Difficult

cable for the main cables suspended from towers on the river banks, and upon which cable the scow travellers run; 48,000 ft. of ¾-in. steel cable for temporary crossings when the channel at the main cables becomes obstructed by moving sandbars; and 90,000 ft. of ⅜-in. steel cable. This small cable passes from the shore to the scow and is reeled on a winch to enable the ferryman to pass stretches of slack water in places where the current forms eddies which do not promote the progress of the scow.

The ferry season commences about the middle of April, and closes when the rivers are so choked with ice as to

Fig. 4—Straw Road Across Sandbar

render it dangerous to cross; this occurs any time from the end of October to the first of December.

The service last season cost the government $120,000, this sum covering the ferrymen's wages, new construction, renewals of scows and cables and tackle, and the maintenance of the approaches to the ferries. In connection with the latter item, approximately 6,000 lineal yards of road were built and maintained during low water, and for the consolidation of sandbars some 350 tons of straw and litter were hauled, with an average haul of three miles.

The present standard ferry scow (see Fig. 1) is 18 ft. in width and 52 ft. in length with two 12-ft. aprons extending beyond the ends of the scow. The carrying capacity of the new boats is figured to take care of four heavy tanks of wheat at one load.

The service is managed by a small office staff at Regina, one field inspector and usually two small construction and maintenance crews who are kept constantly in the field all the year, overhauling the boats in the winter and attending to repairs and approaches in the summer.

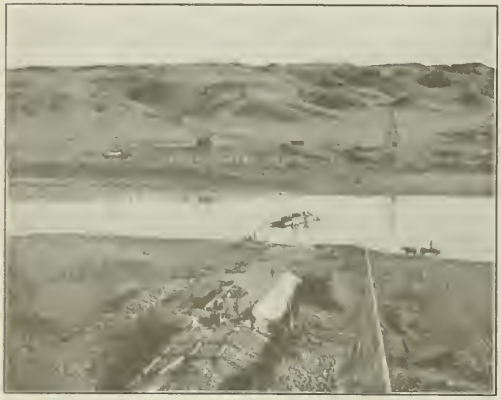


FIG. 5—CONSTRUCTING PERMANENT APPROACH TO FERRY

Fig. 2 indicates the characteristics of the South Saskatchewan river for 250 miles east of the western boundary of Saskatchewan. This view illustrates the sandbars which form at one level of the water, re-form, move and disappear at succeeding stages of the water. This natural feature of this section of the river makes the operation of ferries a difficult problem for the department to contend against. The road in the foreground is a typical road entry to an ascent from the river level to the plateau, which in some places is as high as 300 ft.

Fig. 1 is a fair-weather scene; Fig. 3 shows the difficulties of ferriage prior to the setting in of the severe

FIG. 6—PERMANENT APPROACH COMPLETED

weather. The river is full of "slush" ice, which forms on the ferry scow and obstructs the landings. The ferrymen are required to operate their boats under these conditions as long as possible consistent with safety. In Fig. 3 on the far side of the river can be seen one of the standard cable towers. At most crossings one of these towers is required at each side of the river. The cables (1¼-in. crucible cast steel cables with hemp centres) are suspended from the top of the towers and it is upon these cables that the pulleys of the travellers run. The travellers are connected with the ferry scows by ½-in. cables, which can be seen in Fig. 1.

Fig. 4 shows one method of making a solid road across the loose sand of the bars at points where the ferry scow cannot make a good natural landing. The dark material is successive layers of straw (preferably flax straw) which binds into the sand and makes a solid road for the heaviest kind of traffic.

A permanent ferry landing consists of a rampart of boulders with a concrete cover, the centre being laid with planks. Fig. 5 shows an approach road in the course of construction; also the South Saskatchewan river at its narrowest point, extreme low water. On the far bank the road can be seen entering the hills. The height of the tower on the far bank is 60 ft. The hills in the background are characteristic of the river benches in this vicinity. Fig. 6 is a "close-up" of the completed permanent approach.

TOWN PLANNING IN RELATION TO INDUSTRIAL DEVELOPMENT*

BY C. W. KIRKPATRICK
Industrial Commissioner, Hamilton, Ont.

YOU cannot get the most or the best out of a man unless he is happy and contented. High wages and short hours are not, in themselves, sufficient to make him either. He demands, and he is entitled to, the right to live, and unless you provide him with proper living conditions for himself and his family he will never prove 100% efficient.

I cannot claim originality for either the above paragraph or the thoughts it expresses. They are the words spoken to several others and myself by H. S. Firestone, head of the great Firestone Tire & Rubber Co., but they struck me with much force, and the more I have turned them over in my mind, the more have I become impressed with the idea that they have probably had much to do with Mr. Firestone's success. And they sum up briefly and concisely the few remarks that I intend to make. They may not appear to have any direct bearing on the subject, "Town Planning in Relation to Industrial Development," but when you analyse them I think you will agree with me that they tell pretty nearly the whole story.

In my comparatively brief experience as commissioner of industries for the city of Hamilton, I have found that the first concern of practically all large manufacturers is labor. The availability of a labor supply concerns him more than any one other thing, and the quality of that labor is to him of quite equal importance. In inquiring into the quality of the available labor supply, he invariably seeks a first-hand knowledge of housing conditions. If he finds that the workingmen of the city are properly housed, it does not take much more to satisfy him that the quality of the labor is good, but if on the contrary he finds that the particular class of labor in which he is interested is housed in shacks or tenements, or that the families of the workmen are surrounded by conditions that are not congenial or healthful, it takes more than the persuasive eloquence of an industrial commissioner to convince him that in that community he will find that which is most essential to the successful conduct of his business—efficient labor. In support of that statement (you will pardon me if I make another local reference), a few weeks ago H. W. Hoover, general manager of the Hoover Suction Sweeper Co., of Canton, Ohio, was asked—not by myself but by an indirect representative of the Department of Trade and Commerce—why he had selected Hamilton as the location for the company's Canadian plant, and this is what he wrote in reply:—

"First of all we were most favorably impressed with the seemingly ideal living conditions of the laboring people. The large percentage of these folks who owned their own

*Address at the Southwestern Ontario Town Planning Conference, Hamilton, Ont., November 27th and 28th, 1919.

homes impressed us with the fact that Hamilton must have an ideal labor market."

I trust that I have now successfully connected the expressed thoughts of Mr. Firestone with the subject of this paper, for it has been my aim to show that the city or town that does not give thought in the laying of its development plans to the proper housing of its working people, is badly handicapped in the race for industrial supremacy.

Living at Factory Door

It would be presumptuous on my part to suggest just what class of house is best suited to the requirements of the workingman or is most calculated to do its part toward bringing him and his family that measure of contentment necessary to his efficiency, but I have my own ideas regarding where that house, whatever the plan, should be located; or, rather, where it should not be located. Invariably when it is announced that a large new industry is about to locate in a certain district, there is a rush of builders into that district and the foundations of so-called workingmen's homes soon begin to make their appearance, usually before building operations are started on the factory itself. This, in my opinion, is a mistake. It has been my experience that the average workingman, while desirous of being fairly convenient to his place of employment, is still more desirous of being far enough away from it that it will not be staring him in the face every time he opens his front door, a constant reminder that his hours of rest and recreation are few and that the whistle will soon again be recalling him to toil.

It is quite true that houses built close to the sites of new industries invariably find ready sale or are easily rented, but that is usually because the prospective purchaser or tenant has no choice in the matter. Were they to be consulted, I believe that at least 75% of them would say that they would much prefer to be a few blocks distant but that circumstances forced them to take what they could get. In fact, provided with proper means of transportation, it is my opinion that a large majority of the workingmen would, for the sake of their families, if not for their own sakes, prefer to reside a mile or two from their places of employment, where their growing children would be far removed from the noise and grime of the workshop.

I was recently in a western city where some of the residents expressed great pride in a housing scheme that had been carried out for the benefit of the people employed in a certain factory district. "A model city," they called it. Being interested, I took time to pay the district a visit. What I found was a number of pretty houses, well paved streets and attractive boulevards, but surrounded on all sides by existing factories or factory lands. "If this is a model city, then give me the old-fashioned kind," was the thought that came to my mind, and when I afterwards had an opportunity to talk with the occupants of some of those homes, who, by the way, were not laboring men at all, I found that they were residing there because they could not find any other place to reside.

Industrial and Residential City

I have heard it said that an industrial city cannot hope to become a residential city in the sense that a residential city should be a thing of beauty. The claim that I am about to make would probably come with better grace from someone else, but I cannot refrain from saying that right here in Hamilton we have the answer to that statement, for here nature and man have combined in the building of a City Beautiful and an industrial centre. With but a few exceptions, Hamilton's larger industries are located in the northeast section of the city, on the harbor shore, where the prevailing winds blow the smoke, dust and objectionable odors out over the waters of Hamilton Harbor and Lake Ontario, where they can do no harm.

The residential sections, on the other hand, lie to the south, beneath the shelter of what we are pleased to call "Our Mountain," and where there is little, if any, possibility of their being marred by the industrial life of the

(Continued on page 531)

CORRUGATED PAPER USED TO SEPARATE WOOD BLOCK IN PAVING ST. THOMAS TRACK ALLOWANCE

By John Stanley Crandell
Consulting Engineer, General Tarvia Dept., the Barrett Co.

WOOD block pavement is being laid in the track allowance of the St. Thomas (Ont.) municipal railway by a new method. The old pavement was brick on a sand cushion. When it recently became necessary to replace the worn rails, it was decided to repave at the same time with wood block.

The concrete base which surrounds and covers the sleepers, was brought up so that when the wood blocks are

Spacer in Place Between Rows of Block—Roll of Spacer Material in Background

laid on it they are flush with the top of rail. Instead of laying the blocks on a sand cushion, the smooth concrete base is given a paint coat of paving pitch (145 degs. melting point, cube-in-water method) and the blocks are laid on this pitch paint coat as soon as it has hardened. Hardening takes only a few moments.

The rows of blocks are separated from each other by strips of corrugated paper $1\frac{1}{4}$ ins. wide by $\frac{3}{16}$ in. thick.

Squeegeeing Pitch into Joints

The joints are therefore about $\frac{3}{16}$ in. wide, or less if the blocks are lightly rammed. The joints so formed are then filled to about one-half their depth with coal tar pitch, and the remainder of the joint is swept full of clean sand.

The spacer of corrugated cardboard was used for the first time in June, 1919, in Bridgeport, Conn., in the track

allowance of the Connecticut Co. St. Thomas is the first Canadian city to use it. It permits the pitch filler to find its way to the bottom of every joint, thus insuring a waterproof pavement; it prevents the movement of the pitch after it settles in the joint, and therefore stops effectively any running of the pitch on hot days; and it provides a joint sufficiently wide to take care of any expansion that may take place in the blocks. As the blocks are laid in a pitch paint coat, and as the joints are waterproofed with pitch filler, five of the six faces of each block are protected with pitch.

By filling the joints only half full of pitch, much of the objectionable bleeding often associated with wood blocks is eliminated. The sand that fills the remainder of the joint eventually mixes with the pitch to form a pitch-sand mastic, and an ideal filler is the result.

Along the web of rail a strip of bituminized felt is laid. Paving pitch is poured around this so as to waterproof the pavement from rail to rail.

The work is being done under the direction of James A. Bell, consulting municipal engineer and acting city engineer, and under the immediate supervision of W. C. Miller, assistant engineer.

AMHERSTBURG FILTER PLANT

TO Charles W. Tarr, vice-president of Morris Knowles, Ltd., consulting engineers, Windsor, Ont., *The Canadian Engineer* is indebted for the two accompanying views of the recently completed water filtration plant at Amherstburg, Ont.

An article by Mr. Tarr, briefly describing this plant and relating the history of the Amherstburg waterworks,

BRUNNER-MOND CO.'S FILTRATION PLANT RECENTLY COMPLETED AT AMHERSTBURG, ONT.

appeared in *The Canadian Engineer* for June 5th, 1919. The plant was constructed by the Foundation Co., Ltd., of Montreal, for the Brunner-Mond Co., Ltd., of Amherstburg, who are largely interested in the welfare of that industrial community and decided to furnish it with pure water. The plant was designed by Morris Knowles, Ltd. The filter equipment

ANOTHER VIEW OF THE AMHERSTBURG WATER FILTRATION PLANT

was furnished by the Norwood Engineering Co., of Florence, Mass.

The Canadian channel of the Detroit river is the source of supply. The pumping plant is near the river bank. Power is supplied by the Brunner-Mond Co. and by the Hydro-Electric Power Commission to motor-driven centrifugal pumps. There are duplicate coagulating basins, each affording six hours' coagulation. A concrete tank of 35,000 gals. capacity provides wash water for the filter beds, which have a capacity of 1,500,000 gals. daily, with space for an additional unit when needed. The clear water reservoir has a capacity of 100,000 gals. There are three low-lift pumps and three high-lift pumps, each with capacity of 500 Imp. gals. per minute.

RECENT PUBLICATION

MANUFACTURE OF CHEMICALS BY ELECTROLYSIS.—By Arthur J. Hale; edited by Bertram Blount; published by Constable & Co., Ltd., London, Eng.; 80 pages and cloth cover; 5½ by 9½ ins.; price $1.50 net. The chapter headings are: Electrolytic Hydrogen and Oxygen, Ozone; Production of Per-Salts and Hydrogen Peroxide; Nitric Acid, Hydroxylamine, Hydrosulphites, Fluorine; Electrolytic Preparation of Pigments and Insoluble Substances; Electro-Osmotic and Electro-Colloidal Processes; Electrolytic Reduction of Organic Compounds; Oxidation and Substitution of Organic Compounds.

Correction.—The titles of the two illustrations on page 516 of last week's issue were accidentally transposed. The upper photograph shows the Regina warehouse of the Robert Simpson Co., Ltd., while the building shown in the lower photograph is the publishing plant of Rand, McNally & Co.

The secretary of the British Columbia Technical Association has forwarded to *The Canadian Engineer* the following report of the association's monthly meeting held November 17th, in the Board of Trade rooms, Vancouver: "Satisfactory reports were made on various phases of the association's activities and new plans for future action were outlined. The association has taken an active part in endeavoring to improve the status and salary grading of technical men in the Dominion Civil Service, and for several months past has been in constant correspondence with the authorities at Ottawa regarding the matter. Similar action has also been taken with regard to the regrading taking place under the provincial Civil Service Commission. The committee report at the meeting indicated that while the provincial association was given an opportunity of conferring through a committee with the regrading authorities, the committee chosen did not contain a representative of the technical men in the service. So while the Civil Service Association might perform valuable functions for the general clerical branches of the service, it appeared that in this instance the interests of the technical men were not being adequately presented. A delegation was appointed which left for Victoria the following day to interview the Civil Service Commissioner on the matter. A discussion took place on the hitherto inadequate part which engineers and other technical men have taken in public matters, resulting in it being left to non-technical men to occupy public positions which vested them with control over expenditure of money on engineering and other technical work. A public service committee was formed, with instructions to work to promote and encourage increased interest among technical men in municipal, provincial and national government affairs."

IDEAL CONTRACT-LETTING MADE PRACTICABLE

By Dr. J. A. L. Waddell
Consulting Engineer, Kansas City, Mo.

IS it not obvious that anyone who lets a contract on the "cost-plus" basis places himself absolutely at the mercy of the contractor and the contractor's employees? It is true that the specifications often contain restrictions which tend to lessen the contractor's power to take advantage of the client; but their enforcement would be very troublesome, and would generally involve litigation with its attendant delay and expense.

Even if the contractor has every possible desire to expedite the work in the interest of the client, he cannot prevent his men from taking life easily and "soldiering" on the job. When they feel that their indolence or negligence will cost "the boss" nothing, but, on the contrary, will probably add to his profits, they cannot be induced to labor with the same amount of energy which they would employ if they knew that upon their efforts depends his success or failure.

Most people will acknowledge that the percentage of truly conscientious contractors is not as large as one hundred, . . . but how much smaller is that of truly conscientious workmen! I do not deny that there are workmen who always give a *quid pro quo* and who are upright and honorable in all their dealings; but alas! they are sadly in the minority. Their number is so small that they are unable to induce their co-laborers to exert themselves any more than they are compelled to, unless, perchance, they are paid by the job instead of by the day or hour.

By the way, when it is practicable, such a scheme of paying the workmen is an improvement on that of time-compensation, because it provides a great incentive to effort; but, at the same time, it also serves as a strong temptation to scamp the work. With close supervision, however, and a strict enforcement of the clause in the specifications relating to the taking out and replacing of defectively built work, the employees soon learn, through the fines and penalties enforced by the contractor, that scamping does not pay, and that the old adage of honesty being the best policy is just as applicable now as it was when first enunciated.

Unsatisfactory Contract Forms

So much from the client's point of view, and now let us discuss the question from that of the contractor. In the days of hard times when contractors are willing to take work at low figures, and even below cost, in order to keep their force together, the public in general, especially as represented by companies and municipalities, is prone to take advantage of them by insisting that work be let by the lump sum, and by throwing upon the unfortunate "successful bidder" not only the risk of loss from rising prices of materials and labor and from unforeseen contingencies, but also, in many cases, from excess of quantities above those given in the specifications. This is accomplished by inserting in the latter a most unjust clause compelling each bidder to verify for himself both the quantities stated and the character of the conditions described. The bidders, hungry for work, accept this clause without comment, but with the mental reservation that, in case of hard luck, they will, by some means or other obtain extra compensation, even if they have to carry the controversy into the courts.

In nineteen cases out of twenty it is unjust to bidders to ask them to name a lump-sum compensation for doing work, unless provision be made for a variation in the quantities of materials upon which they tender. If provision be arranged for such variation, the method of letting is no longer that of the "lump sum," but reduces to a modification of that of "unit prices."

The latter method is certainly the more logical, and yet it is far from being entirely fair to the contractor; because, while it provides against loss through excess in quantities of materials, it leaves him open to the possibility of still greater loss through changing prices, onerous unanticipated conditions, and disastrous happenings beyond his control.

The client is the proper party to assume the principal risks inherent to the work, provided that the adverse happenings be really unavoidable by the contractor, and that the latter take every reasonable precaution against disaster or loss.

Principles of Satisfactory Forms

From the preceding it is evident that the "cost-plus," the "lump-sum," and the "unit-price" methods of letting contracts are not only faulty but also unjust to one or other of the two parties to the agreement; consequently, the question arises—"Is there not some method which will be just and fair to both?" That question, I claim, can truly be answered in the affirmative; and I shall now proceed to explain such a method in complete detail.

Let the specifications, which should invariably be drafted by an engineer who is acknowledged to be an expert in the class of work covered in the proposed contract, be complete and thorough in every detail, recording all that is known concerning the governing conditions; pointing out all features concerning which there is any uncertainty; tabulating

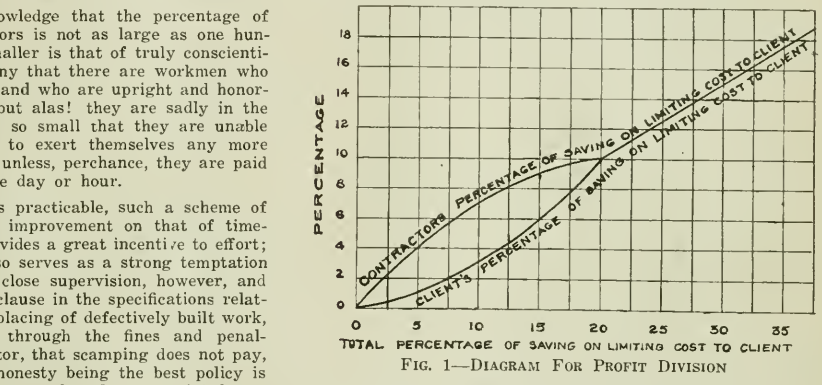


Fig. 1—Diagram For Profit Division

as accurately as possible the estimated quantities of all the materials that will probably enter the construction; providing a justly-drawn clause for unclassified work and the payment therefor; calling for each bidder to name a lump sum so much above his estimate of total cost that there is practically no danger of the actual cost exceeding it, which sum (after modification as hereinafter indicated) shall be the greatest that the client can be called upon to pay for the completed work; naming such properly balanced unit prices for all the materials that, when they are applied to the quantities thereof given in the specifications, the sum of the several ensuing estimates of cost shall exactly equal the limit of cost set in the contract, which unit prices are to be adopted when computing the final payment for the entire work; providing a surety-company bond for the faithful performance of the work and guaranteeing the client against having to pay more than the limiting sum agreed upon (as finally modified); and adopting the following method of profit-sharing between the contractor and the client.

Method of Profit-Sharing

An accurate estimate of cost of every detail of the work from start to finish is to be kept by the contractor and verified by an accountant in the employ of the client, so that the total profit on the job may be ascertained by deducting this total cost from the maximum figure named in the contractor's tender and afterwards embodied in the contract (modified, however, as hereinafter described). This profit is to be shared between the contractor and the client as indicated in the profit diagram. It should be clearly understood that every direct and indirect expense to which the contractor is put in doing the work, after the contract is signed, is to be included in the cost—all overhead expenses of every kind, plant deterioration, traveling expenses, supervision, and salaries, excepting only that the contractor

himself is not entitled to any salary. In the case of a firm being the contractor, the head of that firm should receive no salary; but if any of the juniors devote their time exclusively to the job, it would be legitimate to allow them reasonable salaries, equivalent to what would have to be paid to regular assistants. All such matters, however, should be stipulated in the contract.

In order to determine, after the entire job is finished, the amount due the contractor, the actual quantities of materials recorded are to be multiplied by the unit prices named in the contract, and to the sum of these is to be added the value of all unclassified work (usually denominated "extras"); then from the sum is to be subtracted the lump sum named by the bidder and incorporated in the contract. The ratio which this difference (either a positive or a negative quantity) bears to the said lump sum named by the contractor in bidding is to be figured and adopted in the employment of the diagram of "corrective ratios" for the said difference.

Application of Corrective Ratio

There are two reasons for applying this corrective ratio: First: in the case where the actual quantities of materials exceed the estimated ones of the specifications, it would be

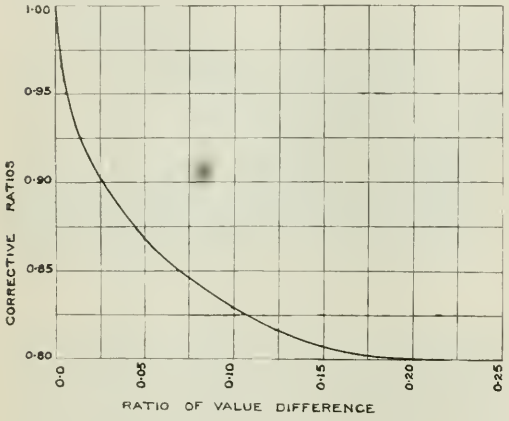


FIG. 2—DIAGRAM OF CORRECTIVE RATIOS

hardly fair to the client to apply to the excess those unit prices which produce his tentative limiting expenditure. Second: in the case where the actual quantities of materials are less than the estimated ones, it would be unjust to the contractor to use the high unit prices on the diminution quantities, not only because of the great difference between these and the unit actual-costs, but also for the reason that the total overhead charges would be about the same for the estimated total quantities as for the diminished amounts.

In the corrective-ratio diagram it will be noticed, that, after the ratio of value difference (due to increase or diminution of quantities of materials) reaches 0.2, the "corrective ratio" remains constant at 0.8, which corresponds approximately to actual cost conditions. The object of this is to provide that the contractor shall not be too much benefited by an abnormal increase in quantities, nor, on the other hand, shall he obtain too much advantage because of an abnormal diminution thereof.

To utilize the corrective-ratio diagram, look on the line of abscissae for the ratio of cost difference, pass vertically upward to the curve (or right line, as the case may be), then horizontally to the extreme left vertical, which will indicate the corrective ratio required. Next multiply the previously computed difference by this corrective ratio and add the result to or subtract it from the limit stipulated in the contract. The result will be the corrected limit, from which must be subtracted the total cost so as to determine the amount of profit to be divided between the contractor and the client, as per the profit diagram.

In order to show the *modus operandi* of this method of profit-sharing, let us assume the following case, in which the estimated quantities are exceeded.

Lump-sum limit tendered $1,700,000
Value of total work done per unit-price list and clause re unclassified work 1,855,000
Total cost of work 1,575,500
Difference = $1,855,000—$1,700,000 = $155,000.
Ratio of difference = $155,000÷$1,700,000 = 0.091.
From Fig. 2 we find the "corrective ratio" to be 0.833; then the corrected difference = $155,000×0.833 = $129,115.
Corrected limit = $1,700,000+$129,115 = $1,829,115.
Profit = $1,829,115—$1,575,500 = $253,615.
Percentage of total profit = $25,361,500÷$1,575,500 = 16.1
From Fig 1, we find the division of this profit to be as follows:—
Contractor 9.4%
Client 6.7%
Total payment to contractor
= 109.4×$1,575,500 = $1,723,597.

Now let us investigate a case in which there is a diminution in the estimated quantities of materials.

Lump-sum limit tendered $1,700,000
Value of total work done per unit-price list and clause re unclassified work 1,615,000
Total cost of work 1,310,000
Difference = $1,700,000—$1,615,000 = $85,000.
Ratio of difference = $85,000÷$1,700,000 = 0.05.
From Fig. 2 we find the "corrective ratio" to be 0.87, then the corrected difference = $85,000×0.87 = $73,950.
Corrected limit = $1,700,000—$73,950 = $1,626,050.
Profit = $1,626,050—$1,310,000 = $316,050.
Percentage of total profit = $31,605,000÷$1,310,000 = 24.1.
From Fig. 1, we find the division of profit to be as follows:—
Contractor 12.05%
Client 12.05%
Total payment to contractor
= 1.1205×$1,310,000 = $1,467,855.

Advantages

The advantages of this method of contract-letting are as follows:—

First.—While it is true that the client at the outset does not know exactly what the work is going to cost him, he is positive that it will *not* cost him more than a certain amount, provided that his engineer's estimate of quantities of materials is about right, as, generally speaking, it certainly ought to be.

Second.—The client has the satisfaction of feeling that, even if, in his opinion, the limit bid by the contractor is excessive, and that the profit on the job in consequence, will be too large, the said profit will be shared between them on a fifty-fifty basis.

Third.—All the advantages of competitive bidding are retained by this method of tendering, because all that a bidder has to do is to name a limiting lump sum with certain unit prices, and to make sure that the latter, when properly applied to the quantities of materials given in the specifications, will produce a total value equal to the said limiting lump sum. All bids will be upon exactly the same basis, no modification of the stipulated method of tendering being permitted, hence the selection of the bidder will be governed solely by the lowest lump sum named, provided, of course, that the one tendering it possesses the necessary experience, capital, plant, and general reputation for doing good and satisfactory work.

Fourth.—The contractor, if he was not too keen in bidding, knows that there is almost no chance whatsoever of his losing money on the job, and that the harder and the more intelligently he works the greater will be his profit.

Fifth.—The division of total profit given in the profit diagram is eminently equitable, in that, when the amount is small, nearly all of it goes to the contractor, and, as it augments, a continually increasing proportion of it goes to

the client, up to the point where the total profit amounts to 20%, after which the partition is on a fifty-fifty basis. This point was selected as being the one above which a contract is generally deemed by contractors to be good, slightly below which it is only fair, and much below which it is bad; for it corresponds to a net profit of 10%. That is as small a margin as is generally deemed safe for any bidder to tender upon, and yet it constitutes a satisfactory profit on a finished job. As for limiting the client's share of the profit to one-half—that is reasonable and just, because he would have no moral right to receive more than his partner, the contractor. If the client's share were allowed to increase beyond the point of equal division, it is conceivable that, with a very large prospective total profit, the contractor could save money for himself by making the work more expensive.

Sixth.—The contractor will feel during the progress of the construction that the client is a partner on the job, and that, therefore, he and his engineers will not be likely to be unnecessarily severe in their requirements, also that they will permit the adoption of all legitimate expense-saving expedients, and will not demand too many frills on the finishing.

Seventh.—Owing to the justice and equity involved by this method of contract-letting and profit-sharing, all concerned in the execution of the work will labor whole-heartedly and good-naturedly, avoiding petty squabbles and disagreements of all kinds; and the result will be earnest, honest effort, a satisfactory piece of construction, and the general contentment of both parties to the agreement.

Adoption of Method

If this proposed method of contract-letting and profit-sharing be received with favor by engineers, architects, contractors and builders in general, it could easily be adopted as a standard for the country by calling a small convention with a single representative from each of the leading technical and railroad societies, contracting organizations, and bankers' associations, to discuss the advisability of adopting it (or else some slight modification of it) and to report the decision of the meeting to the said bodies for their approval. If any large group of clients, such as the railroad companies, were to adopt the method as standard and use it, very soon everybody having construction contracts to let would follow their example, thus making it the universal standard of contract-letting for our country—nor would it be long before other American countries would follow our lead, thus greatly simplifying our business relations with the various American commonwealths.—From "Contracting," of Chicago.

The Asphalt Association has opened a branch, or district, office in Washington, D.C., in charge of Maj. Harry D. Williar, formerly of the Maryland Road Commission and later with the Paving Commission of Baltimore.

The following resolution was adopted last month at the Canadian Mining Institute's convention in Vancouver: "That the formation of a Canadian Association of Engineers, for the purposes of social service, mutual protection and legislation is desirable and in the best interests of the public and of the profession."

The directors of the Engineers' Club, Toronto, have decided to increase the entrance fee from $50 to $100, effective January 1st. All applications received this month will be subject to the former rate. The directors announce that they have no intention at the present time of increasing the present annual dues.

The annual election of officers of the Toronto branch of the Engineering Institute of Canada was held last Thursday night at the Engineers' Club, Toronto, with the following results: R. O. Wynne-Roberts, chairman; executive committee—Geo. T. Clark, Thos. Taylor, Prof. C. R. Young and J. C. Krumm. W. S. Harvey was re-elected secretary, but as he has moved to the United States, his successor will be appointed by the executive committee. The new officers will assume office about January 20th, 1920.

THE RAILWAY SITUATION IN CANADA TO-DAY

WILLIAM FRANCIS TYE, formerly chief engineer of the Canadian Pacific Railway, addressed the Montreal branch of the Engineering Institute of Canada last Thursday, the title of his address being "The Railway Situation in Canada To-day."

Transportation, said Mr. Tye, is a more important question in Canada than in any other part of the world on account of its geographical position. The Dominion is divided into an eastern area, comprising Ontario, Quebec and the maritime provinces, and a western area including Manitoba, Saskatchewan, Alberta and British Columbia, the two areas being separated by long stretches of barren territory. In the west the products are mainly agricultural, which have to be transported east, whilst the manufacturing products of the east are carried to the western provinces.

Government Has Always Helped

There are 39,000 miles of railroad in Canada, giving one mile to every two hundred people. This is practically equal to Germany with her 75 million population, to India with 330 million, and nearly as much as Russia with 170 million. The rates are low, considerably lower than those obtaining in the United States, and the service is good.

From very early days the Federal government has always helped the railways. The first assistance was a grant of $35,000,000 and 18,000,000 acres of land given to the Canadian Pacific. Subsequently, the grant became 3,200 acres per mile for cheaper lines and 6,400 acres per mile for those lines which cost more than $15,000 per mile to build. The third scheme conceived was the issuing of guarantee bonds, which was done on the theory that the guarantee would never be called upon, but the liability has proved to be tremendous. The guarantee on parallel lines, which was given later, appears to have been especially disastrous.

Why have the railways failed? asked Mr. Tye.

In 1906, all privately owned roads were prosperous; the C.P.R. and G.T.R. were rich, and the C.N.R., though not paying dividends, was doing well. Now the C.N.R. and G.T.R. are bankrupt, and only occasionally in late years have they earned the cost of operation of their roads.

There has been keen rivalry as to which should become the second transcontinental railway. Bond guarantees given by a liberal government enabled the G.T.R. to build 3,900 miles of main and 1,200 miles of side lines. Similar guarantees by a conservative government assisted the C.N.R. to extend their system from 2,000 to 10,000 miles. This rapid construction, and the way in which it has been carried out, has resulted in the bankruptcy of both railroads.

It has been said that "Railroads were opened first and built afterwards, i.e., in advance of civilization." This meant light revenues, and, of necessity, light expenses. Steep grades, few turnings, light rails, few terminals are necessary in building a new line in virgin territory. As the revenue increases, steam shovels can be employed to make big cuts and fills at a smaller cost than would have been incurred by using light equipment, new depots and sidetracks can be constructed, and the road can be made a good one. Heavy expenditure of money in the early stages of development is not justified, as the interest amounts to large sums. At 5% money doubles itself in fourteen years.

G.T.P. Too Expensive Construction

The Grand Trunk has always been accustomed to deal with the east, with Ontario, the United States, etc., having immense traffic, and there has always been need of heavier rails, more sidetracks, and more terminals to take care of this traffic. In expanding in the west, they have built a very expensive line, giving a fine road, with better grades than those obtained on the C.P.R., but their revenue has been insufficient to pay operating expenses and fixed charges. The parent company in the east have been getting into difficulties, and finally have had to give up the western line.

The Canadian Northern have a good western line, which has been paying well, but, desiring to become transcontinental, it has built east to a country already well served with railroads. To do so, it has had to parallel other roads to Montreal and Toronto, and has found it very costly to obtain proper terminals. The C.N.R. has a small yard in Montreal, but no freight yard, while the C.P.R. has some fifteen to twenty freight terminals in the city. The C.N.R. cannot hope to compete, as the public will not haul freight a long distance in order to reach a yard.

The C.N.R. commenced by buying old, poor-paying roads in Ontario and Quebec. The company have built north from Toronto, and, where a single track would suffice, there are now three roads; it parallels the G.T.R. from Toronto to Kingston. The C.P.R. also covers this area, and there exist one double and two single tracks, when one double track is amply sufficient to take care of the traffic. It has been proved that there is not enough traffic on the expensive line in Ontario, and the company has become bankrupt.

G.T.R. and C.N.R. Mistakes

The mistake of the G.T.R. has been the building of a main line in the west, which was not justifiable, and that of the C.N.R. the extension of its line east to traffic centres already occupied.

There would be no railway problem to-day had the government adopted a policy of this nature in dealing with these railroads: "The G.T.R. has a good eastern road, the C.N.R. the beginnings of a good western road. Let them get together and connect their roads. We will give money to assist them in carrying this out, and later, in developing their line to the Pacific Coast." Instead of this, the government aided the roads in parallel.

If the solution some years ago had been consolidation, still more is that the case now, with the extra roads in Northern Ontario. Another reason which has an important bearing on this question is the future return of the railroads to private ownership. The lines must be prosperous before any company will consider taking them over, and if the lines were consolidated, they would be in good physical condition. It is the best system in the east, with the G.T.R., C.N.R. and other government lines, and is very good in the west. It has the shortest line from Winnipeg to Toronto and Montreal, good grades, reasonable curves, and the easiest route across the mountains.

The railways are in a very unfortunate position financially. Statistics for the year ending June 30th, 1918, give the following data:—

Loss on old government railways	$ 5,800,000
Loss on C.N.R.	11,675,000
Loss on G.T.R. and subsidiaries	10,250,000
Total losses	$27,725,000

The interest on the Intercolonial at 4% and on the Transcontinental at 3% amounts to $11,000,000, giving a total of losses and interest payments of $39,000,000.

Summing up costs of government railroads, and figuring interest on these at another $11,000,000, the absolute total reaches a figure of $50,000,000. The net earnings for the year 1918 of the C.P.R., acknowledged to be one of the most successful railways, amounted to $34,500,000. The other railroads have to face a possible yearly deficit of $50,000,000—one and one-half times the earnings of the C.P.R.—and the problem to-day requiring solution is, How are they to continue and be made prosperous?

Must Increase Freight Rates

"First," continued Mr. Tye, "give an immediate and decided increase in freight rates. This will have a very slight effect on the cost of living. The cost of transportation in Canada is very cheap, indeed, and, compared with Australia, the rates in Canada are about one-third those obtaining in that country."

Reference was made by Mr. Tye to an article on "The Railway Problem," by C. W. Baker, published October 23rd, 1919, in the Engineering News-Record, of New York, in which a table was given showing the increase in cost price of an article when freight rates are increased 50%. This table is reprinted herewith.

It is admitted that an appreciable increase does occur on such articles as coal and grain where transportation forms a large part of the final cost, but in the case of clothing, shoes, sugar, butter, fresh meat, etc., if the freight rates are raised 50%, nobody would notice the subsequent difference in cost. Therefore, the first step towards a solution is to raise freight rates, independent of the fact whether the railroads are run by private or government management.

The second step towards solution is to decide whether the railroads shall be privately owned or owned by the government. Mr. Tye stated he knew of no railroad which was successful under government management except in Germany, and the success there was due to the reasons that the roads were built for a large population; that they were not run as commercial enterprises, but solely for war domination; and that the workers were employees of the state, and as such could not strike.

The Intercolonial had as much business per mile as the C.P.R., yet it had never earned interest, and only for two or three years has it earned sufficient money to pay operating expenses. Sir Henry Drayton and Mr. Ackworth, who were members of the Royal Commission appointed to inquire into the railway question, have stated. "We know of no democratic state where the railways are owned by the government but where politics have a large bearing on the railways and the railways a large bearing on politics." No man works for a government as well as he will for a private concern. The margin between success and failure is very slight, and this has been emphasized by Lord Shaughnessy in a speech delivered about a year ago. C.P.R shareholders paid $112 for $100 worth of common stock, and $31 was added from sur-

How a 50% Increase in Freight Rates From Marketing Centres to Consuming Centres in U.S.A. Would Affect Cost of Products

Refined oil, Tulsa, Okla., to Cleveland, 960 miles, rate 38.5c. per 100 lbs. An increase of 50% would mean 1.3c. per gallon.

Fresh meat, Kansas City to Pittsburgh, 898 miles, rate 52c. per 100 lbs. An increase of 50% would mean ¼c. per lb.

Cattle, Dallas to Kansas City, 484 miles, rate 33.5c. per 100 lbs. An increase of 50% would mean 1/6c. per lb.

Potatoes, Houlton, Me., to New York City, 567 miles, rate 30c. per 100 lbs. An increase of 50% would mean 8c. per bushel.

Lumber, Winona, Miss., to Philadelphia, 1,160 miles, rate 33c. per 100 lbs. An increase of 50% would mean 5.37c. per 1,000 ft.

Oranges, Palatka, Fla., to Pittsburgh, 1,121 miles, rate 62c.* per 100 lbs. An increase of 50% would mean 31c. per crate.

Grain, Fargo, N.D., to Chicago, 640 miles, rate 18.5c. per 100 lbs. An increase of 50% would mean 4.6c. per bushel.

Grain products, Chicago to Baltimore, 749 miles, rate 19.5c. per 100 lbs. An increase of 50% would mean 9.7c. per 100 lbs.

Butter, St. Albans, Vt., to Boston, 315 miles, rate 65c.* per 100 lbs. An increase of 50% would mean ½c. per lb.

Anthracite coal, Carbondale, Penn., to Springfield, Mass., 308 miles, rate $2.75 per gross ton. An increase of 50% would mean $1.23 per net ton.

Bituminous coal, Cresson, Pa., to Chatham, N.Y., 476 miles, rate $2.40 per gross ton. An increase of 50% would mean $1.07 per net ton.

Iron ore, Ashtabula, Ohio, to Latrobe, Penn., 170 miles, rate 93c. per gross ton. An increase of 50% would mean 46c. per gross ton.

* Rates in effect January 1st, 1919.

plus revenue, making $143 for a $100 share. Last Wednesday's quotation was $138. Seven per cent., which is the highest dividend paid on railway stock, only amounts to 2¼% on the cost of the railway system, or, taking the dividend at 10%, which includes interest on other branches of the company's affairs, the amount is 2½% on the total of the company's assets. In 1895 the company paid no dividend; in 1897, 2½%; in 1901, 4%; in 1904, 6%, and only in 1907, twenty-six years after formation, was the maximum dividend of 7% reached.

The difference between government and private operation is very large, and it is difficult to realize how government operation, pure and simple, can ever be a success. Drayton and Ackworth had proposed that a company, named the Dominion Railway, be formed, with the stock vested in the company, and managed by a self-perpetuating board of men unattached to any government Mr. Tye did not think there was enough difference between this arrangement and pure government operation to make it a success. One parliament cannot prevent another parliament following it from making changes, and the dangers inherent to government operation are inherent to this system also.

Government operation has been tried in the United States for two years, but the public are now clamoring that the railroads be turned back to private ownership. The only solution for Canadian railroads is to return them also to private owners, making compensation for the irreparable damage done to the roads by government operation. A new company should be organized to take the roads over as private concerns. Possibly the government would have to aid the private companies, but that would be better than a deficit every year. The solution of Canada's railway problem, Mr. Tye claimed, is (1) Increase the freight rates; and (2) return the railroads to private ownership.

ENGINEERING INSTITUTE ELECTIONS

At a meeting of the Engineering Institute of Canada held November 25th in Montreal, the following elections and transfers were announced:—

Members.—P. L. Allison, Peterboro, Ont.; C. W. Dill, Regina, Sask.; G. R. Langley, Peterboro, Ont.; W. R. MacDonald, St. Catharines, Ont.; W. O. Marble, Vancouver, B.C.; J. W. Morrison, Dane, Ont.; P. B. Roberts, London, Eng.; E. R. Shirley, Peterboro, Ont.; C. E. Sisson, Peterboro, Ont.; C. W. Tarr, Windsor, Ont.; P. P. Westbye, Peterboro, Ont.

Associate Members.—G. B. Anderson, Ottawa, Ont.; Capt. B. L. Barns, Peterboro, Ont.; C. B. Bate, Ottawa, Ont.; C. H. Blanchard, Winnipeg, Man.; A. F. Bookhout, Peterboro, Ont.; J. S. Brisbane, Montreal East, Que.; Lieut. C. F. Corbett, Cardston, Alta.; W. F. Coutlee, Ottawa, Ont.; John Craig, Nelson, B.C.; J. W. Crashley, Toronto, Ont.; J. B. Croly, Vancouver, B.C.; S. L. Decarteret, La Tuque, Que.; Maj. Philip Earnshaw, Toronto, Ont.; Lieut. W. J. Fletcher, Windsor, Ont.; Maj. J. H. Forbes, Smith's Falls, Ont.; C. A. De W. Fowler, Armdale, N.S.; A. B. Gates, Peterboro, Ont.; T. E. Gilchrist, Peterboro, Ont.; A. J. Gray, Toronto, Ont.; Capt. E. K. Hall, Edmonton, Alta.; P. C. B. Hervey, Edmonton, Alta.; S. A. Lanzon, Toronto, Ont.; J. O. Martineau, Quebec, Que.; D. L. McLaren, Peterboro, Ont.; H. T. Melling, Regina, Sask.; Lieut. F. H. Palmer, Halifax, N.S.; Lieut. W. G. Perks, Peterboro, Ont.; W. J. Pickrell, St. John, N.B.; Lieut. G. C. Reid, Cobalt, Ont.; Charles Robertson, Peterboro, Ont.; Capt. H. L. Roblin, Red Deer, Alta.; N. D. Seaton, Peterboro, Ont.; C. V. Stout, Winnipeg, Man.; A. L. Sutherland, Peterboro, Ont.; H. H. Tripp, Edmonton, Alta.; A. S. Weekes, Edmonton, Alta.; George Blanchard, Port Arthur, Ont.; T. M. Jones, Toronto, Ont.; S. S. Kennedy, Winnipeg, Man.; S. D. H. Pope, Victoria, B.C.; J. A. W. Waring, St. John, N.B.

Associate.—G. C. McAvity, St. John, N.B.

Juniors.—C. T. Evans, Windsor, Ont.; R. E. Hinton, Peterboro, Ont.; E. L. Holmgren, Peterboro, Ont.; Lieut. H. A. Lynch, Ottawa, Ont.; R. D. McKenzie, Winnipeg, Man.; J. F. Patterson, Montreal, Que.; J. H. Reid, Peterboro, Ont.; L. De B. Roy, Ottawa, Ont.; C. B. Shaw, Hawkesbury, Ont.; R. E. Stavert, Peterboro, Ont.; Lieut. D. C. Wills, St. Catharines, Ont.; Maurice Cossette, Montreal, Que.; J. E. Lyon, Ottawa, Ont.; Stewart Schofield, Winnipeg, Man.; Capt. R. D. Thexton, Ottawa, Ont.

Transferred, Associate Members to Members.—J. N. Finlayson, Winnipeg, Man.; S. J. Fisher, Montreal, Que.; A. R. Greig, Saskatoon, Sask.; G. H. Herriot, Winnipeg, Man.; Maj.-Gen. G. B. Hughes, Derby, Eng.; Maj. W. G. Swan, Vernon, B.C.; F. B. Tapley, Moncton, N.B.

Transferred, Juniors to Associate Members.—Capt. F. X. Amos, Corinth, Ont.; Lieut.-Col. D. S. Ellis, Kingston, Ont.; J. M. Gibson, Toronto, Ont.; F. H. Hibbard, Sherbrooke, Que.; Lieut. S. E. McColl, Winnipeg, Man.; Ernest Peden, Montreal West, Que.; Maj. G. R. Taylor, Grafton, Ont.; E. E. Wells, Toronto, Ont.; Capt. Walter Youngman, Winnipeg, Man.; J. N. Aggiman, Port Alfred, Que.; G. M. Hudson, Montreal, Que.; B. L. Nares, Montreal, Que.; P. O. Spicer, London, Eng.

Transferred, Students to Associate Members.—Capt. A. L. Cavanagh, Winnipeg, Man.; L. G. McNeice, Wallaceburg, Ont.; Charles Bruce, Ottawa, Ont.; E. V. Gage, Montreal, Que.; E. P. Muntz, St. Catharines, Ont.; E. S. Smyth, Kitchener, Ont.

Transferred, Students to Juniors.—H. H. B. Loignon, Outremont, Que.; J. A. Vance, Woodstock, Ont.; A. P. Black, Toronto, Ont.

TOWN PLANNING IN RELATION TO INDUSTRIAL DEVELOPMENT

(Continued from page 525)

city. There is no denying the presence of certain flies in the ointment, so to speak, from a town planning viewpoint, but to those who have witnessed it, I think the view from the mountain top bears out the claim I have made—that it is possible so to plan a city that it may be an industrial centre and at the same time an attractive residential city. Were it possible to go back to the beginning, I would say that, looked at from the viewpoint of both manufacturer and the dweller, it would be advisable to set apart industrial areas wherein no dwelling should be built, and residential districts the doors of which would ever remain closed to industrial and commercial enterprises, but just how far town planners should be permitted to go in disturbing existing conditions, I am not prepared to say. I can see how they might easily defeat what I understand to be their aims—the development and betterment of the community.

What I have already said has dealt almost entirely with houses and workingmen. Before I close, let me suggest that town planning should, if it does not now do so, give quite as careful consideration to the laying out of the industrial areas as it gives to the residential sections. If a city desires new industries, or if it wants to see its existing industries prosper and expand, it must provide them with the proper facilities for doing business. In every city that I know of, heretofore when a new industry came along it was permitted to acquire a tract of land and locate its buildings regardless of what effect its actions would have on the industrial development of adjacent lands. The result is that we have more railway switches crossing the streets than would have been necessary had the industrial areas been properly planned in advance, while in some cases large tracts of land otherwise suitable for industrial purposes have been cut off from railway connections altogether, rendering them unsuited for factory uses, while they are practically useless for other purposes. These are conditions that exist right here in Hamilton, and to my knowledge in some other Canadian cities.

Care should also be given to the laying out of the streets in industrial districts. They should be so arranged as to lead to the commercial and residential districts by the shortest possible routes consistent with good town planning and the general scheme for the development of the community, for it is important that it should be made as easy as possible for the working people to get from the factory to their homes and from their homes to the factory, and it is equally important that the manufacturer should be able to

deliver his finished products as quickly as possible to the railway freight sheds or local distributors.

On the extent and nature of the town planning of to-day, to a very large measure depends the extent and nature of the future industrial development of every industrial centre. It would not be difficult to show that the industrial development of to-day has been very greatly influenced by the happenings of years ago. And so it will be always. Town planning and industrial development are very closely related.

THE FUTURE DEVELOPMENT OF THE SOUTH SHORE OF THE ST. LAWRENCE RIVER, OPPOSITE THE CITY OF MONTREAL

INCLUDED in the proposals of the Harbor Commissioners of Montreal for the development of Montreal Harbor is a bridge spanning the St. Lawrence river from the docks to a point on the south shore, crossing St. Helen's Island in midstream.

Ernest Drinkwater, consulting engineer, Montreal, in a report to the South Shore Board of Trade, comments on the present stagnation of the municipalities located on the south shore, owing to lack of transportation facilities, and strongly urges the commencement of work on this bridge, in order to provide labor to many grades of workmen now unemployed, and to assist in the development of the south shore territory. It will be noticed from the sketch that Mr. Drinkwater suggests that the southern half of the bridge be diverted to a point approximately 600 ft. down the river. Subsequent to the date of the first plan of the proposed bridge, the Harbor Commissioners have secured control over some 60 acres of property, 4,100 ft. long by 700 ft. in depth, which consists of the whole of the river frontage of the ordnance lands of the federal government. The suggested diversion gives direct access to this land, and unless the change is made, the railroad traffic will have to switch back in order to get to the river from; and that this will entail considerable interference with the proposed civic development of the south shore, is claimed by Mr. Drinkwater.

It will be observed that the Quebec, Montreal and Southern Railway and the old Grand Trunk and South Eastern Railways, whose rights of way are still available for use, can very conveniently connect with the proposed location. It is the earnest desire of those interested in the natural development of the south shore, to keep the railways on the river front as far as possible, and within those areas which will be reserved for the suggested future improvement of the south-east side of Montreal Harbor. Following is an abstract of portions of Mr. Drinkwater's report:—

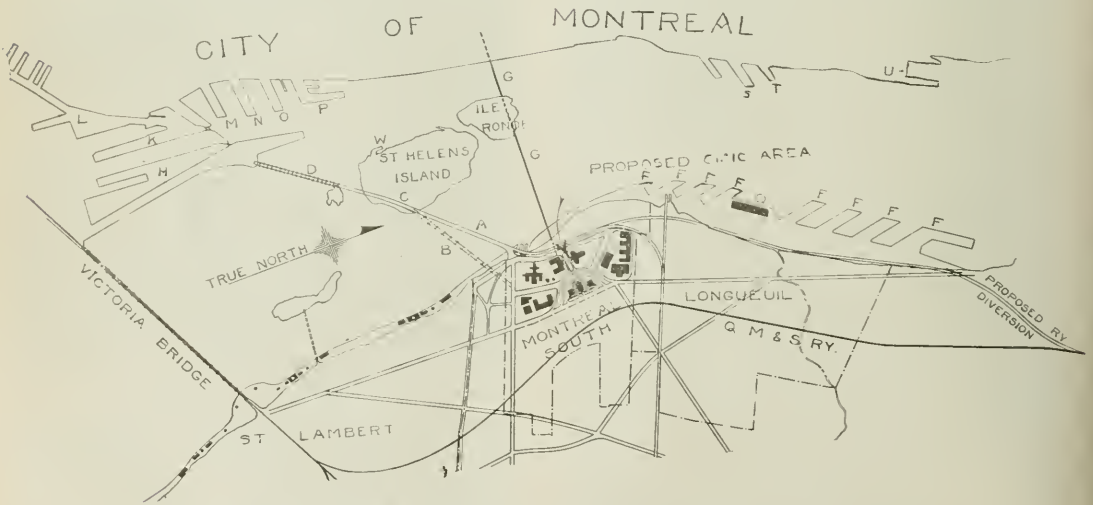
This bridge should be of sufficient width to give passage for all the public services, such as railways, tramways, driveway and footpath, electrical conductors, telephone wires and gas mains, and being built by public money, the public should be given the utmost service therefrom. Having more than a local importance, there should be organized immediately a board of engineers to direct the construction in conjunction with the Harbor Commissioners.

The condition of the south shore to-day shows that its development has been strangled by the lack of proper transportation facilities, and the exorbitant tolls charged over the Victoria Bridge by the Grand Trunk Railway. In addition to the steam railway track, this bridge only permits a single line suburban tramway service, a 3-ft. sidewalk and a 14-ft. driveway.

Vehicles must pass over the steam tracks in order to gain access to the driveway, and vehicular traffic suffers considerable delay owing to the heavy through traffic and shunting. The narrow width of this driveway is responsible for damages (from overhanging loads of other vehicles) often incurred by motor cars.

One of the objectionable tolls to be paid by the people on the south shore is $100 per year for a telephone wire passing over the mile and a quarter of bridge. This is an extra paid by the customer in addition to the service.

While these conditions exist, it is hardly possible that any general development can take place, and it is questionable if there is a parallel to this situation in any part of the world; that is to say, a district with so small a population, opposite a city approaching a million inhabitants, at the head of navigation of one of the largest rivers in the world, which has an ever-growing traffic. The whole of this district has a population of only about 12,000, with absolutely no harbor development and less river front activity than existed 70 years ago. Thirty millions have been spent to develop the Montreal side of the harbor during this period, and practically not a cent on the south shore. Seventy years ago there were three railways serving Montreal which had their terminal points on the south shore. On the building of the Victoria Bridge, the three lines were brought together, and taken over this bridge to the Island



PLAN OF MONTREAL HARBOR AND SOUTH SHORE, INDICATING SUGGESTED IMPROVEMENTS

B, C, D, Location for new bridge proposed by Harbor Commissioners; A, diversion proposed by South Shore municipalities; F, proposed docks; G, proposed tunnel (to Montreal central terminal); H, basin for inland and coasting vessels; K, Windmill Point basin; L, Lachine canal; M, N, O, P, S, T, docks; U, Vickers dry dock and shipbuilding plant; W, concrete ferry-wharf.

of Montreal. The south shore lost the advantage of these terminals, and thus the Victoria Bridge performed a two-fold purpose,—but to the detriment of the south shore.

The proposed new bridge will fulfil many functions for the general benefit of all. For the railways, it can be the means of connecting the two systems of the National Railways of Canada. The Canadian Northern section from the Mount Royal tunnel can pass over this bridge and join the Intercolonial system, the G.T.R. line to Portland the Central Vermont and the Quebec, Montreal and Southern Railway (D. & H.). All these railways could reach the business section of the city of Montreal and save a distance of five to seven miles, by making use of this bridge. The bridge would give the National, Transcontinental and Canadian Northern access to the United States, without having to go to the Quebec Bridge and come back to St. Hyacinthe, some 250 miles, and there is no doubt that the saving, to the Government railway alone, would go a long way towards payment of the cost of the bridge. To the city of Montreal it would reduce the delay on the many street crossings between Bonaventure and St. Henry.

The south shore is waiting to receive the suburban tramways service it requires in order to develop, as the distance to the centre of the populated area would be reached in seven to eight minutes from the foot of McGill St.

The people of the city of Montreal, and of the south shore, would have access every day of the year to the beautiful park in the centre of the river (St. Helen's Island), by tramway in a run of five minutes. This would save the city many thousands a year now paid for ferry service. The driveway would give vehicular traffic an entrance to the city of Montreal that would be a credit to the city and province, and obviate the present route, which the tourist traffic from the United States and the intervening part of the province have to follow to get into the city. The bridge could carry many public utilities to the advantage of the city of Montreal and the south shore.

Town Planning Needed Now

With the building of this bridge, there should be enforced upon the south municipalities a definite plan of development, as within two miles of the debouching point of this bridge, there are five municipalities, each composed of various subdivisions laid out without any regard to their neighbors, much less to the lines of communication with the adjoining municipality. There is only one direct means of communication between these municipalities, and that is the River road, which is impassable in the winter time, and, at the present time, this is the only road communicating with the site of the proposed bridge.

It is of urgent necessity that the South Shore Board of Trade should proceed with the proposition for the formation of the Town Planning Commission, in order to lay out the lines and method of rational development of the future city on the south shore. If this cannot be brought about by amalgamation, then the provincial authorities should step in and deal with the matter, as the present situation is impossible. Only one of the towns is zoned for trade, commerce and dwelling areas, and the lack of proper building regulations for the protection of the health and property of the residents exists in most parts of the district.

For the benefit of the towns themselves, and the province generally, it is urgent that immediate action be taken, before any general development occurs on the present lines of the layout of the district. If this is not done, it will cost millions in the future to do what can be better done for thousands now.

Suggested Civic Centre

With the amalgamation of these municipalities there is a site for a civic centre on the south shore end of the bridge, second to none in the Dominion. This property is owned by the Department of Militia and Defence, and has been lying idle for upwards of half a century. It has a frontage on the river of three-quarters of a mile, and an area of about 170 acres. In addition to having the largest frontage on the river of any lot in the county of Chambly, it is also one of the highest standing properties, considering its depth from the river, and on it could be grouped the city hall, court house, library, art gallery, hospital, market, armory and customs house. The whole could be given a setting that would compare favorably with the departmental buildings at Ottawa. The carrying out of a scheme as outlined and the construction of the bridge would assist in placing before the public a residential district, within a few minutes of the centre of the city of Montreal, which would have the added advantages of the country and a waterfront.

Dyke and Boulevard

If the federal government is desirous of finding work for the unemployed, there is no work that could be started of a more useful nature than on the bridge according to the adopted plans of the Harbor Commissioners. The building of this bridge will necessitate the opening of a channel, averaging approximately 2,000 ft. wide, and probably 18 ft. deep, and which is estimated to contain nearly 15 million cubic yards of material to be excavated. Half of this would build a dyke and boulevard, and form flood protection work 300 ft. wide from the Laprairie Dyke to the proposed new bridge. This material could be utilized to provide a magnificent boulevard, with areas reserved for all recreation purposes, at very little cost, as the dredging will have to be done, and the dyke is a necessity.

Opportunity for New Elevator

It has been stated that there is need in the harbor for another grain elevator, where railway cars, lake and inland navigation boats could be unloaded, and, at the same time, where ocean-going tramp and other ships could be loaded with grain in a few hours. With the railway facilities which will be available when the bridge is constructed, there is a splendid opportunity for the Harbor Commissioners to start the development of the hitherto neglected south shore by building a record-beating grain elevator of, say, ten million bushels. (See Q on sketch.) The Railway Board might consider commencing the work of preparing the existing rights of way and approaches to the new bridge. These are now available. On the development of a general city planning scheme, assistance might be received from the Provincial Department of Municipal Affairs to carry out some of the work of urgent necessity.

At a meeting of the Peterborough branch of the Engineering Institute of Canada, held last Saturday, the following officers were elected for the coming year: Honorary chairman, R. B. Rogers; chairman, Reid Munro, sales manager of the William Hamilton Co., Ltd.; vice-chairman, R. H. Parsons, city engineer; secretary, R. L. Dobbin, water works engineer; treasurer, D. L. McLaren; executive committee—E. R. Shirley, A. L. Killaly, G. R. Langely, C. E. Sisson, P. L. Allison and P. P. Westbye.

The people of the Border Cities in Ontario voted last Saturday to purchase the Sandwich, Windsor & Amherstburg railway from the Detriot United Railway, and to place it in the hands of the Hydro-Electric Power Commission of Ontario for operation and maintenance. In an interview with Sir Adam Beck last Monday at London, Ont., the "Hydro" chief pointed out that of the $23,000,000 involved in the proposed purchase of certain electric railway lines which will form the beginning of the Hydro-radial system of Ontario, the people have voted to buy or build more than $17,000,000 worth. Those which the people have voted for to date include the Toronto to St. Catharines line via Port Credit and Hamilton; the Welland and Bridgeburg line; the Toronto and Northeastern; and the Sandwich, Windsor & Amherstburg railway. The lines yet to be voted upon include the Toronto & Bowmanville railway and the line from Hamilton to Galt, Guelph and Elmira. The Sandwich, Windsor & Amherstburg railway will be the first radial to be operated by the Hydro commission, although a commission of which Sir Adam Beck is chairman and which is appointed by the London city council, operates the London & Port Stanley railway.

PIECE-WORK SYSTEM IN METER READING*

By J. A. A. Beaudin
Of Montreal Light, Heat & Power Consolidated

THE supply of public utilities involves the performance of numerous routine operations in the consumer's home by various categories of employees operating individually and without supervision.

The reading of meters in situ, the delivery of bills and collection notices, and the collection of arrears are a few of these operations.

Until recent years, and even nowadays, the general practice has been to remunerate employees engaged in these various tasks on a flat or fixed rate salary, based either on the hour, day, week or month, with additional privileges (in many cases) respecting sickness, holidays, etc.

Salaried Worker Leaves No Residue

This mode of remuneration makes possible the payment of wages for labor which has been only partially supplied, and since the actual supervision of his work is impracticable, the employee is tempted to take advantage of this condition occasionally, if not regularly, to limit his activities, and the means he may use to conceal his shortcomings are only limited by his ingenuity and his morality.

Furthermore, an employee working under this system of remuneration is inclined to complete indiscriminately each task as he encounters it, without any regard whatever to the amount of time and expense involved—i.e., he will often devote an unwarranted amount of time to straightening out a difficulty which if reported to the office could be handled much more expeditiously and economically by an expert. In other words, a worker on a fixed salary does not by-pass difficulties—he leaves no residue.

Piece-Worker Leaves a Residue

This state of affairs has led our company to devise and introduce a system of payment on a piece or commission basis as applicable to the various categories of these employees. This piece-work or commission system keeps the employee at his work, insures the full employment of his time, limits his absences from duty, prevents the payment of unearned wages, and regularizes the output—it helps get the work done regularly and systematically, but it leaves a residue.

The piece or commission worker is interested in handling a maximum of cases in a minimum of time, so naturally the tendency is to handle the straight-going jobs and by-pass difficulties whenever encountered, no matter what the employer's interest; the employee's interest is in the opposite direction, as every stop he makes to overcome difficulties limits his wages, hence while this system has removed the necessity for outdoor supervision, it has created a demand for closer indoor supervision over the work performed, and the piece-work system must be supplemented by a faithful follow-up system of by-passed jobs, without which it would prove a failure and cease to be economical and practical.

Workers Exchange Districts

The piece-work system only works advantageously in districts where the clientele is dense or semi-dense; it is not effective in districts where the clientele is scattered. The piece-worker is entitled to a supply of work commensurate with his capacity, and his work requires to be properly sorted and routed so that he may carry it on under advantageous conditions. The employer's interest also demands this in order to keep the piece-work rating at a minimum and at the same time afford the employee an opportunity of earning a fair remuneration thereunder. Failure to give proper attention to this detail would result in the establishment of a higher piece-work rating than would otherwise be necessary.

*Excerpt from paper read at the last annual meeting of the Canadian Gas Association.

Employees of the same category should all be on an equal footing and be given equal opportunities. They should permute periodically from one district to another in order that one and all may cover each district and the entire system in a given period. All districts do not afford similar or equal opportunities and no one should be allowed to work continuously in either a good, poor or medium district, but all should have their turn in each.

Activities Cannot be Limited

The piece-worker, although not a tracer, a trouble straightener or a worker fitted to operate in scattered districts, must be efficient and capable of discharging his duties in a competent manner and carrying to a satisfactory conclusion all work entrusted to his care. While he is quite within his rights in by-passing real difficulties and not spending his time in conducting long searches, etc., he must positively not be allowed to by-pass for trifling causes any of the work entrusted to him.

It is not desirable to limit the activities of a piece-worker with a view to securing work of a higher standard, as he cannot fairly be retained in service without sufficient work to keep him employed, and even if allowed to go off duty as soon as he has performed his limited task, he will work just as hastily in order to get through and go off duty, and the employer's very object—viz., to cause him to move more slowly and perform work of a better quality, will be defeated; furthermore, the resultant limitation of his earning power is likely to cause the piece-work rating to go up. An energetic piece-worker with a large working capacity will earn "record" wages when supplied with unlimited work and will indirectly contribute to the maintenance of an economical and moderate piece-work rating. Furthermore, the employee who earns large wages will have every inclination to perform his work in accordance with instructions—his very interest in his position is the best guarantee to be wished for in this connection. A proper inside supervision over the work involved in the completion of by-passed jobs, as reported by the piece-worker from time to time, affords the employer a still further protection. This inside supervision is a most important feature of the piece-work system and must be exercised with constant vigilance.

Having now dealt with the economic aspects of the piece-work system, it may be of interest to outline briefly its operation in our company, especially as applied to our meter readers.

Saturday Devoted to "Pick-Ups"

We supply "dual service" (gas and electricity) and issue part of our bills on a bi-monthly basis and part on a monthly basis. The ordinary gas and electric lighting consumers are billed bi-monthly, while the larger consumers and all electric power users are billed monthly. Our territory is divided into meter reading districts and the work distributed in accordance with schedules, so that the readings repeat themselves on about an even calendar date in each district. Twenty-two men take care of our meter reading on a piece rating per meter. These men work five days per week on regular readings; every Saturday morning is devoted to each man "picking-up" the readings which he has by-passed for various reasons during the current week. This "picking-up" work is done at the regular rating for current readings. After the completion of this "picking-up," the residue of by-passed readings reported to the office represents only such cases as present unusual obstacles. The fact that each meter reader must appropriate a certain amount of time to "picking-up" his own by-passed readings is an added protection against by-passing for trifling causes. When reading meters in a district where the clientele is scattered, the meter readers are paid an additional flat rate sum per district; this rate varies from 50c. to $2.00 per meter book. A somewhat similar system is in vogue in connection with power and special clients billed monthly, as such customers are limited in number and distributed all over the system. In addition to the regular staff two special meter readers are also employed on a combined fixed salary and piece-work basis to take care of readings by-passed by the regular readers.

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"CLOSING" THE PROFESSION IN ENGLAND

IN view of the fact that the Engineering Institute of Canada and the Joint Committee of Technical Organizations have recently drafted proposed legislation defining the status of the engineer in Canada, it is of interest to note that a Bill will be introduced in the next session of the British House of Commons to regulate and to establish registration for the civil engineering profession. The principal provisions of the Bill are as follows:—

By "civil engineer" is meant a person competent in the art described in the Royal Charter of the Institution of Civil Engineers of 1828 and its subsequent development through the advance of science. The definition of the profession of civil engineering is generally attributed to Thomas Telford, the first president of the institution, and reads as follows:—

"The art of directing the great sources of power in nature for the use and convenience of man, as the means of production and of traffic in states both for external and internal trade, as applied in the construction of roads, bridges, aqueducts, canals, river navigation and docks for internal intercourse and exchange, and in the construction of ports, harbors, moles, breakwaters and lighthouses, and in the art of navigation by artificial power for the purposes of commerce, and in the construction and adoption of machinery, and in the drainage of cities and towns."

The register as first established would contain: (a) All corporate members of the Institution of Civil Engineers and of the Institution of Civil Engineers in Ireland; and (b) other persons who are engaged as civil engineers and are members of important engineering societies; or who, although not members of such societies, have been engaged in civil engineering practice for a substantial period.

It is proposed that there be a time limit for the application of these conditions to the formation of the register. For the purpose of determining the elegibility of engineers in the second group, a tribunal is to be established upon which the important engineering societies are to be represented, and by means of which the interests of their members who are civil engineers will be safeguarded.

ECONOMICS OF PLACING CONCRETE

MOST engineers agree that in order to use concrete towers and spout the mixed materials long distances, the mixture must be wetter than good practice would dictate. The work of Professor Abrams at the Lewis Institute, Chicago, has brought to the attention of the engineering profession more sharply than ever before the harmful effect of excessive water upon the strength of concrete. It is generally conceded that in order to use towers, from 30% to 50% more water must be used than if the materials are placed by other means. With this in mind, owing to the detrimental effect of too much water upon the strength of concrete, several construction companies have practically tabooed the use of towers.

Engineering opinion appears to have been modified somewhat upon this point during the past year, however, and it is becoming more clearly recognized that the whole problem is one of economy, and that towers are justifiable if by their use money can be saved in placing the concrete, provided that the proper cement-water ratio is adhered to at all times. Many engineers to-day are saying to their contractors:—

"Use towers if you wish, but you must keep the cement-water ratio constant. When you add more water in order to use your chutes, you must add sufficient extra cement to maintain the same cement-water ratio. If the use of your towers saves you more money than the extra cement costs, you are wise to use towers; but if the cost of extra cement is much greater than the additional cost of getting the concrete into the forms in some other way, it would pay you to abandon your towers."

PERSONALS

J. G. SULLIVAN, consulting engineer, Winnipeg, has been elected as a member of the Winnipeg city council.

C. F. GRAY, electrical engineer, Winnipeg, Man., has been re-elected mayor of that city by more than 2,500 majority.

SIR ADAM BECK, chairman of the Hydro-Electric Power Commission of Ontario, expects to sail on Saturday next for England, on personal business.

J. M. STEVENSON, of Calgary, who recently returned from overseas, has been appointed resident architect at that city for the Public Works Department of the Dominion government.

HON. LIONEL H. CLARKE, who was recently appointed lieutenant-governor of the province of Ontario, has withdrawn his resignation as chairman of the Toronto Harbor Commission and has agreed to continue in that office at the request of the other members of the commission.

ROBERT FLEMING, civil engineer, of Aberdeen, Scotland, has joined the financial firm of J. & L. M. Wood, which will hereafter be known as Wood, Fleming & Co. Mr. Fleming served with the Canadian forces overseas. For several years prior to the war he was a railway contractor in this country.

STUART S. SCOVIL, of the Dominion Water Power Branch, Ottawa, has been appointed engineer in charge of the hydrometric surveys in the province of Ontario, and JAMES R. BISSETT, of the same branch, has been appointed assistant engineer. This work in Ontario has formerly been taken care of by the Hydro-Electric Power Commission, but by arrangement with that commission it will be done in the future by the Dominion Water Power Branch, whose records will be used by the commission.

A. H. HARKNESS and R. E. W. HAGARTY, Toronto, have been appointed joint consulting engineers for the proposed

18-story addition to the King Edward Hotel, Toronto. Watt & Blackwell, of Toronto, Ont., have been retained as associate architects to prepare the plans for the United Hotel Co.'s architects, Essenwein & Johnson, of Buffalo, N.Y.

Lt.-Col. Dougall Carmichael, minister without portfolio in the recently elected Ontario cabinet, has been appointed by the provincial government as its representative upon the Hydro-Electric Power Commission of Ontario. Hon. I. B. Lucas retains his seat on the commission for the time being at least, so that at present all three positions on the commission are filled, Sir Adam Beck remaining as chairman.

Charles Sumner Lund Hertzberg, who was recently relieved of his military duties after having been in the army since December, 1915, has returned to private practice in Toronto and, in partnership with Thomas R. Loudon, has formed a new firm, Loudon & Hertzberg, consulting industrial and structural engineers. Mr. Hertzberg was born June 12th, 1886, in Toronto, and was educated at the Toronto public schools, St. Andrew's College (Toronto) and the School of Practical Science, University of Toronto, from which he graduated in 1905, taking a post-graduate course in 1905-6. Having spent his summer vacations on C.P.R. location work, he joined the staff of that railway in the fall of 1906 as a transitman on maintenance. He was employed in 1907 by the Trussed Concrete Steel Co., in their Toronto office, as a draftsman and designer. In the latter part of 1907 he joined the construction staff of the Concrete Engineering Construction Co., but returned to his previous position with the Trussed Concrete Steel Co. early in 1908. A few months spent on electric railroad maintenance with the Dominion Power & Transmission Co., Hamilton, Ont., intervened prior to his appointment, in the spring of 1909, as chief engineer of the Trussed Concrete Steel Co. at that company's office in Walkerville, Ont. In 1911 Mr. Hertzberg joined the Bishop Construction Co. as Toronto manager, and in the following year became a member of the firm of James, Loudon & Hertzberg, consulting engineers, Toronto, and was engaged in structural and municipal undertakings until he joined the Engineering Training Depot at Ottawa in December, 1915. On New Year's Day, 1916, he sailed for England as lieutenant in charge of a reinforcement draft, and in England he was assigned to the 7th Field Company, Canadian Engineers. That company crossed to France in April, 1916, and Mr. Hertzberg continued with them until he was wounded in January, 1917. In Corps Orders of December 5th, 1916, he was gazetted to receive the Military Cross for his work on the Somme. Invalided to Canada in July, 1917, he became adjutant at the Spadina Ave. Hospital, Toronto, and was promoted to captain and officer commanding casualty company. He was transferred to No. 2 Service Company in July, 1918, and in September, 1918, he joined No. 16 Field Company, Canadian Engineers, at Brockville, Ont., as second in command. Mr. Hertzberg went to Siberia with No. 16 Field Company, sailing from Vancouver October 11th, 1918, and at Vladivostok he was attached to the force commanded by Major-General Elmsley. Mr. Hertzberg's company was the only engineering unit with the force, and it was employed on water supplies, the construction and repair of barracks, the repair of roads, and other work. In April, 1919, Mr. Hertzberg was placed in command of the company, with the rank of major. Two months later he returned to Canada with the headquarters staff of the expeditionary force.

J. Duchastel de Montrouge, who was recently nominated for a vice-presidency of the American Road Builders' Association, has been notified that he has been elected vice-president of the Northeastern District of that association. Mr. Duchastel is a past president and director of the Canadian Good Roads Association.

William Gore, of Gore, Nasmith & Storrie, consulting engineers, Toronto, has sailed for England on a business trip, which is to include an investigation of the latest developments in the treatment of trade wastes and sewage disposal.

J. E. Milne, municipal engineer of Burnaby, B.C., has been selected by the Saanich municipal council, Vancouver Island, as municipal engineer for that district. Mr. Milne was in the Canadian army during the war, and since his return from overseas has been with the Burnaby municipality.

Robert Verity, of Toronto, a well-known labor contractor who has supplied upwards of 100,000 men to contractors and manufacturers in Ontario during the past sixteen years, will said for England next week in order to investigate the prospects for increasing immigration during the coming year. Mr. Verity expects to return to Canada in February.

William R. Worthington, engineer of sewers, Works Department, city of Toronto, has resigned and will enter private practice in Toronto. Mr. Worthington is a civil engineering graduate of the University of Toronto, class of 1905. During his summer vacations, while at the university, he was connected with the Roadway Department of the city of Toronto, and after graduation he was appointed assistant sewer engineer. In 1912 he was appointed engineer in charge of the sewer section. During his tenure of office the sewer section has carried out work costing nearly $8,000,000 and has made several reports on proposed schemes, including sewage disposal for the entire city and sewerage scheme for North Toronto. Besides the amount above mentioned, Mr. Worthington also supervised the expenditure of large sums annually for the maintenance of the entire sewerage system of the city. During the absence of F. A. Dallyn, provincial sanitary engineer, who went to Siberia last fall with the Canadian expeditionary force, Mr. Worthington acted as consulting engineer to the Ontario Board of Health.

OBITUARY

Stephen Pearson Brown, formerly chief engineer of the Mount Royal Tunnel & Terminal Co., Ltd., Montreal, was drowned last Sunday in Sebec Lake, Maine. Mr. Brown was pulling his nine-year-old son on a sled when the ice broke under him and he sank before the boy could summon help. Mr. Brown was about forty years of age. He was a graduate of the Massachusetts Institute of Technology, and before going to Montreal had been associated with the construction of the Pennsylvania Tunnel in New York City. He went to Montreal in 1912 in charge of the Mount Royal Tunnel project and superintended the design and construction until the work slackened in 1916, when he returned to the United States as vice-president and manager of Ford, Bacon & Davis, a well-known firm of engineering contractors of New York City. Mr. Brown continued to act in a consulting capacity in regard to the Montreal terminal work for the C.N.R., and was expected in that city this month on business in connection with the C.N.R. enterprise. From 1915 to 1917 he was a member of the council of the Canadian Society of Civil Engineers. Mr. Brown was also a member of the Institution of Civil Engineers of Great Britain, the American Society of Civil Engineers and numerous other engineering, railway and scientific societies.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand or proposed, contracts awarded, changes in staffs, etc.

ADDITIONAL TENDERS PENDING

Not Including Those Reported in This Issue

Further information may be had from the issues of *The Canadian Engineer*, to which reference is made.

PLACE OF WORK	TENDERS CLOSE	ISSUE OF	PAGE
Bamfield and Ucluelet, B.C., wharf repairs	Dec. 22.	Nov. 27.	52
Banff, Alta., construction of bridge	Jan. 7.	Dec. 4.	45
Crowland Tp., Ont., water mains	Dec. 18.	Nov. 20.	46
Edmonton, Alta., telephone poles	Dec. 10.	Dec. 4.	52
Finch, Ont., road construction	Jan. 19.	Dec. 4.	45
Montreal, Que., briquetting machinery	Dec. 14.	Nov. 6.	54
North Battleford, Sask., power plant equipment	Dec. 20.	Dec. 4.	54
Owen Sound, Ont., reconstruction of wharf	Dec. 12.	Nov. 27.	52
Saskatoon, Sask., sale of 750 k.w. generator	Dec. 12.	Nov. 27.	52
St. John, N.B., construction of grain conveyer equipment	Dec. 9.	Nov. 27.	52
Winnipeg, Man., hydrants and valves	Dec. 15.	Nov. 27.	46

BRIDGES, ROADS AND STREETS

Batiscan, Que.—The MacKinnon Steel Co., Ltd., of Sherbrooke, Que., has been awarded the contract for the steel superstructure of the highway bridge which the Quebec provincial government has arranged to erect over the Batiscan River on the Montreal-Quebec Highway. This bridge, which is over 1,200 feet long, will be one of the largest highway bridges in the province of Quebec.

Belleville, Ont.—City council intends to construct asphaltic concrete pavements on Ann, Charles, William and John Sts. at a total estimated cost of $92,461.20. City clerk, J. Wilfred Holmes.

Belleville, Ont.—City council will construct an asphaltic concrete pavement on Bridge and Pinnacle Sts.

Brockville, Ont.—Leeds and Grenville county councils passed a by-law designating several roads as county roads for improvement under the Highways Improvement Act.

Galt, Ont.—City council intends to construct a cement concrete sidewalk on Hobson St.

Guelph, Ont.—The city council and Wellington County Council are considering the erection of a new bridge on Victoria Road. City engineer, F. McArthur.

Halifax, N.S.—Tenders addressed to the Provincial Highways Board, Halifax, N.S., and endorsed on the envelope, "Tenders for Annapolis and Allen Creek Bridges," will be received up to noon of January 5th, 1920. Plans and specifications may be obtained upon application to the office of the Provincial Highways Board, Halifax, N.S.

Hamilton, Ont.—Works Department plans grading of parts of Connaught Ave., Beechwood Ave., Cannon St. and Balsam Ave.; cement sidewalks on Homewood Ave. and King St.; cement curb on Tisdale St., and grading work on McKittrick Boulevard, King and Dundas Sts.

Hastings County, Ont.—A Mud Creek bridge between Wollaston township, in this county, and Chambers township, Peterboro' county, is to be rebuilt. County road superintendent, H. G. Bleecker, Frankford, Ont.

Megantic County, Que.—County council plans construction of gravel road. Secretary-treasurer, L. Houde, Plessisville, Que.

Niagara Falls, Ont.—American Can Co. plans erection of bridge. Manager, E. R. Coulson.

Ottawa, Ont.—City council will petition the Quebec government to take over and maintain as a government highway the road from Eddyville to Aylmer.

Port Credit, Ont.—Plans have been prepared by the Toronto-Hamilton Highway Commission, 49 Wellington St. East, Toronto, for a small bridge near here.

Riviere du Loup, Que.—Contract let to Philippe St. Laurent by town council for paving of several roads.

Sarnia, Ont.—The Lambton county council passed a by-law to borrow $20,000 to spend in building and maintaining good roads.

St. Etienne, Que.—Tenders will shortly be called for construction of 3 miles of bituminous macadam road. Engineer, M. Paradis, Roads Department, Parliament Buildings, Quebec.

St. Thuribe, Que.—Municipal council intends to construct gravel road. Secretary-treasurer, J. E. Naud, St. Thuribe.

Three Rivers, Que.—Tenders will shortly be called for construction of macadam road. Estimated cost, $28,000. Secretary-treasurer, Z. Forest, 14 Royal St., Three Rivers.

Toronto, Ont.—City council intends to grade Hanson St., from Coxwell Ave. to Hillingdon Ave., at a cost of $1,327.

Toronto, Ont.—City council passed by-law authorizing the grading of Hillingdon Ave. and Stacey St., work to be done by day labor.

HYDRO-ELECTRIC POWER COMMISSION OF ONTARIO

RAILWAY DEPARTMENT

STEEL SUPERSTRUCTURE OF RAILROAD BRIDGE ACROSS HYDRO-ELECTRIC POWER COMMISSION CANAL AT MONTROSE, ONTARIO

ADVERTISEMENT FOR TENDERS

Sealed tenders will be received until Monday, 22nd day of December, 1919, at 12 o'clock noon, addressed to Sir Adam Beck, Chairman, Hydro-Electric Power Commission of Ontario, 190 University Ave., Toronto, Ontario, and marked "Tender for M.C.R.R. Bridge at Montrose."

Plans, specifications and other information may be obtained by applying to the office of the Chief Engineer. The Commission reserves the right to reject any or all tenders received.

Hydro-Electric Power Commission of Ontario.
W. W. POPE,
Secretary.

Dated at Toronto, December 10th, 1919. 388

Toronto, Ont.—Works Committee is considering the grading of Woodbine Ave. and extending Norway Ave. The former improvement will cost $115,000 and the latter $40,000.

WATER, SEWAGE AND REFUSE

Belleville, Ont.—City council decided to construct sewers in Dufferin Ave. and Victoria St. City clerk, J. Wilfred Holmes.

Courtright, Ont.—At the January elections the ratepayers will vote on a by-law to construct a waterworks system. Clerk, A. C. Quick.

Crowland Tp., Ont.—Council let the contract for the construction of a waterworks system in Welland South to Somerville and Dilworth. Over 8,000 feet of water pipes are to be laid and work is to start at once. Three tenders were received: Somerville and Dilworth, 58 cents a ft.; Mitchell and Mows, 68 cents a ft., and Mr. Triboni, Niagara Falls, 85 cents a ft.

Dundas, Ont.—In an address delivered at St. Catharines Noulan Cauchon, town-planning expert, of Ottawa, submitted a proposal that the Grand River be dammed and the water diverted from it to Dundas as part of a scheme of irrigation

East Kildonan, Man.—Tenders addressed to the reeve and council will be received at the office of Harry Thomson, secretary-treasurer, Rural Municipality of East Kildonan, up to 12 o'clock noon on Monday, December 15th, 1919, for the following works and materials: For the installation of sewers and plumbing in seven houses; sewer and water main in Winterton Ave., from East Kildonan Rd. to Brazier St.; for supplying water pipes, valves, hydrants and fittings. Plans and specifications may be seen on application to J. W. Battershill, Engineer, Municipal Hall, East Kildonan.

East Nissouri Tp., Ont.—Township council plans construction of drainage system. Clerk, J. W. Sutherland, Lakeside, Ont.

Galt, Ont.—City council intends to construct sanitary sewers and storm drains in Dickson Park, Myrtle Ave., Oxford, Huron, Portland and James Sts. Total estimated cost, $14,699.25. City clerk, Joseph McCartney.

Guelph, Ont.—City council may construct a sewer on Preston St., from Fergus to Yorkshire St. City engineer, F. McArthur.

Guelph, Ont.—City council proposes to construct a drain in St. Patrick's Ward.

Guelph, Ont.—City Engineer F. McArthur will present a report to the city council on the proposed repiping of the waterworks line from the pump-house to the springs. Approximate cost, $100,000.

Hamilton, Ont.—The Works Department will construct a two-inch water main to the Smallpox Isolation Hospital at a cost of $3,500.

Hamilton, Ont.—The tender of the W. C. Brennan Construction Co. of $10,170 for concrete pipe was accepted by the Cemetery Board.

Hamilton, Ont.—Works Committee considering laying of water main in Benson Ave. and pipe sewer on Roxborough Ave.

Logan Tp., Ont.—Contract let to Wm. Gaffney, R.R. No. 2, West Monkton, Ont., by township council for construction of drain. Estimated cost, $4,902.

Nanaimo, B.C.—City council plans extension to water supply system. Clerk, A. L. Rattray.

Niagara Falls, Ont.—Contract for the construction of sewers on Elm, Morrison, Homewood, Fifth and Sixth Streets was awarded to the City Engineer's department. There were ony two bids:—A. G. Smeaton, supt. construction for city, $14,024.90, and C. A. Lorenzo, $18,139.37.

Oshawa, Ont.—Gore, Nasmith and Storrie, Engineers, Toronto, are preparing plans of a sewerage system for Westmount, College Hill and other parts of the town where there are no sewers.

Ottawa, Ont.—City council intends to construct tile pipe sewers on several streets at a cost of $8,886.47. City clerk, N. H. H. Lett.

Ottawa, Ont.—City council intends to construct sewers on Rockliffe Way, Maple Lane and Springfield at a total estimated cost of $8,300. Commissioner of Works, A. F. Macallum.

Outremont, Que.—Work will start almost immediately on construction of incinerator. City engineer, J. Duchastel de Montrouge.

Owen Sound, Ont.—Plans will be prepared for a system of storm sewers for the town. Engineer, D. H. Fleming.

Regina, Sask.—The Department of Highways, provincial government, intends to construct the Melaval drain at an estimated cost of $6,756.37. Deputy Minister of Highways, H. S. Carpenter.

Stratford, Ont.—City council will have a 300-ft. storm drain constructd on Douro St. City clerk, R. R. Lang.

Sudbury, Ont.—Town council intends to construct a number of sanitary sewers at a total estimated cost of $31,608.09; also several water mains at a cost of $5,294.54. Clerk, W. J. Ross.

Toronto, Ont.—Works Committee decided to construct water mains on Windermere Ave. and Connolly St.

Vancouver, B.C.—The city council voted the sum of $75,000 to relieve unemployment for the next four months through the carrying out of a general scheme of needed street work, waterworks and sewer extensions. City engineer, F. L. Fellowes.

Welland, Ont.—City council intends to construct a 6-inch cast-iron water pipe with the necessary fire hydrants, valves, etc., on the River Rd. at an estimated cost of $3,714.88 City clerk, C. M. Stapf.

West Zorra Tp., Ont.—Tenders will be received by the municipal council up to December 15th, 1919, for the construction of the J. R. McKay, Frank McLeod and David Thomson drains, and also for following tile: 740 ft., 7-in.; 1,560 ft., 8-in.; 2,700 ft., 10-in.; 235 ft., 12-in. (clay tile only), f.o.b., Bennington. Clerk, Allan Murray, R.R. No. 6, Embro, Ont.

Winnipeg, Man.—Tenders addressed to the chairman, Committee on Fire, Water, Light and Power, will be received at the office of C. J. Brown, city clerk, up to 3 o'clock p.m. on Monday, December 15th, 1919, for the supply of 2,000 feet Class "C" 12-inch cast-iron water pipe, delivered f.o.b. city yards, Winnipeg; freight and duty paid. Specification may be obtained at the office of W. P. Brereton, City Engineer, 223 James Ave.

York Tp., Ont.—Township council intends to construct 6-inch cast-iron water mains in Earlsdale and Watford Aves. at total cost of $1,720. Clerk, W. A. Clarke, 40 Jarvis St., Toronto.

York Tp., Ont.—Tenders will be received by the township council up to noon on Saturday, January 17th, 1920, for the supply of cast-iron pipe, cast-iron specials, gate valves, hydrants and cast-iron valve covers and frames. Specifications may be obtained on application to Frank Barber, Township Engineer, 40 Jarvis St., Toronto.

LIGHT, HEAT AND POWER

Chatham, Ont.—Public Utilities Commission plan extension to Hydro-Electric system to cost $90,000. Manager and engineer, J. S. Jackson.

Winnipeg, Man.—Tenders addressed to the chairman, Committee on Fire, Water, Light and Power, will be received at the office of C. J. Brown, city clerk, up to 3 o'clock p.m. on Monday, December 15th, 1919, for the manufacture and supply of from 400 to 500 tons of steel required for extension to the generating station of the City Light and Power Department. Specification may be obtained at the office of the City Light and Power Department, 54 King St.

Barrett Specification Roofs

20 Years of Service Guaranteed—

IN the old days buying a roof very often proved to be something of a gamble. Maybe you got just what you specified, and maybe not.

The cost per square foot was too often taken as the only standard of value—frequently to the owner's subsequent sorrow.

Today all this is changed.

It was The Barrett Specification which first made it possible for building owners everywhere to obtain, through their local contractors, a *standardized roof*, worked out by roofing engineers and based on scientific principles of modern roof construction.

Today we offer to *guarantee* Barrett Specification Roofs *for a period of 20 years!*

This guaranty is obtainable on any roof of 50 squares or more, in any town of 25,000 population or over, and in smaller places where our Inspection Service is available.

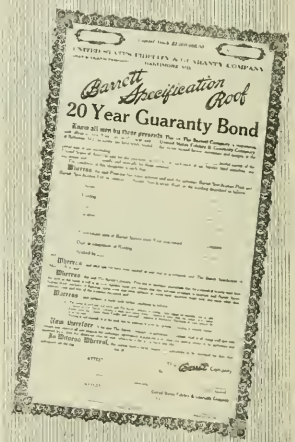
It is a Surety Bond, issued by a well-known Fidelity and Guaranty Company.

To obtain this Surety Bond you have only to insert in your building specifications the following:

> "The roof shall be laid according to The Barrett Specification dated May 1, 1916, and the roofing contractor shall secure for me (or us) the 20-Year Guaranty Bond therein mentioned."

The guaranty costs you nothing. We merely require that the roofing contractor be approved by us and that we be given an opportunity to inspect the construction.

We shall be glad to send you a copy of *The Barrett Specification*, with diagrams, ready for insertion in your building plans.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The 20-Year Bond

We illustrate above the 20-Year Surety Bond that will be given on all roofs of 50 squares or over in towns of 25,000 population or more and in other places where our Inspection Service is available.

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LIMITED

MONTREAL TORONTO WINNIPEG VANCOUVER
ST. JOHN, N.B. HALIFAX, N.S. SYDNEY, N.S.

Barrett Specification Roof, guaranteed for 20 years, on Laval Hospital, Quebec City, Que. Architects: Taylor & Vallon, Quebec City, Que. General Contractor: Gosselin, Quebec City, Que. Roofing Contractor: Eugene Falardeau, Quebec City, Que.

Guelph, Ont.—A by-law to issue debentures for $75,000 for the construction of a new gas-holder will be submitted to the people at the January elections.

Nokomis, Sask.—By-law will be submitted for approval for erection of electric lighting plant to cost $21,000. Secretary-treasurer, W. A. Armour.

Shawinigan Falls, Que.—Shawinigan Water and Power Co. have plans prepared for two steel towers and transmission line. Engineer, C. R. Lindsay.

Winnipeg, Man.—Tenders addressed to the chairman, Committee on Fire, Water, Light and Power, will be received at the office of C. J. Brown, city clerk, up to 3 o'clock p.m. on Monday, December 15th, 1919, for the supply and delivery of 195 tons, more or less, of ⅜-inch Siemons-Martin galvanized steel-stranded cable for the power transmission line between Winnipeg and Point du Bois. Specifications may be obtained at the office of the City Light and Power Department, 54 King St.

Winnipeg, Man.—Tenders addressed to the chairman, Committee on Fire, Water, Light and Power, will be received at the office of C. J. Brown, city clerk, up to 3 o'clock p.m. on Monday, December 15th, 1919, for the supply and delivery, f.o.b. Winnipeg, of 490 miles, more or less, of bare aluminum cable and 10,000 lbs., more or less, of bare aluminum tie wire, with necessary sleeves, for the transmission lines of the City Light and Power Department. Specification may be obtained at the office of the City Light and Power Department, 54 King St.

Winnipeg, Man.—Tenders addressed to the chairman, Committee on Fire, Water, Light and Power, will be received at the office of C. J. Brown, city clerk, up to 3 o'clock p.m. on Monday, December 15th, 1919, for the supply and delivery of 7,000, more or less, 72,000-volt transmission line insulators for the transmission lines of the City Light and Power Department. Specifications may be obtained at the office of the City Light and Power Department, 54 King St.

RAILWAYS

Calgary, Alta.—A large constructive and repair programme in connection with the street railway is planned for next spring, according to Commissioner Graves.

Cobalt, Ont.—Capt. I. W. Solloway, engineer, Toronto, proposes to construct a railroad in northern Ontario's mining and lumbering area.

Sarnia, Ont.—The construction of a spur line railway at a cost of $37,500 is being considered by Lambton county council.

Toronto, Ont.—City council instructed Commissioner of Works Harris to proceed with construction of double car track on Bloor St. West.

FACTORIES AND LARGE BUILDINGS

Austin, Man.—Merchants Bank of Canada are erecting branch bank costing $10,000.

Barton Tp., Ont.—Township council will erect memorial hall at cost of $35,000. Clerk, A. G. E. Bryant, Mount Hamilton, Ont.

Beaverton, Ont.—Sterling Bank, 48 King W., Toronto, will remodel building for bank.

Belleville, Ont.—City council passed a resolution to borrow $200,000 next year from the Ontario government under the Municipal Housing Act.

Berthier, Que.—Work has been started on a huge match factory here, estimated to cost $2,000,000. The promoters are American capitalists.

Brandon, Man.—The Kiwanis Club proposes to build a children's home costing approximately $25,000. President, Dr. H. O. McDiarmid.

Brantford, Ont.—The Women's Hospital Aid plans to build a Children's Ward at the General Hospital in 1920.

Canwood, Sask.—Tenders addressed to Harry W. Baker, secretary-treasurer School District No. 2939, Canwood, Sask., will be received up to January 1st on the erection of a two-roomed brick school building. Plans and specifications may be obtained from the secretary-treasurer.

Chatham, Ont.—It has been decided to erect a gymnasium in connection with the Salvation Army Hostel here. Approximate cost, $6,000.

Dartmouth, N.S.—Royal Bank of Canada, Hollis St., Halifax, N.S., plans erection of bank. Local manager, G. Burnham Mitchell.

Dundas, Ont.—Plans for the construction of a new garage and auto repair shop for Jerome Bros. are being prepared. Approximate cost, $12,000.

Edmonton, Alta.—Nesbitt and Co., Williamson Block, have general contract for addition to bank costing $20,000 for Bank of Toronto.

Estevan, Sask.—Plans will be prepared for warehouse for Imperial Oil, Ltd., Estevan.

Fredericton, N.B.—Trustees of Victoria Public Hospital considering erection of new wing to hospital. President, Mr. Hawkins.

Galt, Ont.—A movement is on foot here for erection of Y.M.C.A. building.

Glace Bay, N.S.—Glace Bay Poultry Association plans erection of exhibition building.

Goderich, Ont.—Town council plans erection of hall and market building. Chairman of committee, Wm. Campbell.

Goderich Tp., Ont.—Township council plans erection of community hall. Clerk, Adam Cantelon, Clinton, Ont.

Granby, Que.—Tenders addressed to R. C. Desrochers, secretary, Department of Public Works, Ottawa, will be received until 12 o'clock noon, Tuesday, December 16th, 1919, for alterations and additions to post-office, Granby, Que. Plans and specification can be seen at the offices of the Chief Architect, Department of Public Works, Ottawa; the caretaker, Public Buildings, Granby, Que., and of the Overseer of Dominion Buildings, General Post-office, Montreal, Que.

Hamilton, Ont.—The Hamilton Scientific Association plan erection of building.

Hamilton, Ont.—By-law authorizing an expenditure of $50,000 on improvements to the Mountain Sanatorium will be submitted to ratepayers.

Hamilton, Ont.—Tenders are being called by B. H. Prack, architect and engineer, 50 Bay St., Toronto, for erection of factory for Firestone Tire & Rubber Co., Firestone Park, Akron, Ohio.

Hanna, Alta.—Tenders will be called next spring for erection of school addition estimated to cost $35,000.

Heisler, Alta.—Public School Board plans erection of new school. Tenders will be called.

Kingston, Ont.—Definite plans have been made for the proposed new stadium and rink at Queen's University. Estimated total cost, $70,000.

Kitchener, Ont.—A new theatre is to be erected on the site now owned by Irvin R. Roos on King St.

London, Ont.—London Housing Commission plans erection of at least 200 houses in 1920.

London, Ont.—The Bell Telephone Co. has decided to add another story to its central exchange at a cost of $100,000, and to install a twenty-six operator switchboard.

London, Ont.—Plans are being made for a commencement on the construction of the new half-million-dollar St. Peter's Theological Seminary early in the spr[illegible] according to an announcement made by Philip Pocock, ch[illegible] of the Building Committee.

Moncton, N.B.—Geo. A. Fuller Co., 285 Be[illegible]l Hill, Montreal, have general contract for concrete [illegible] for T. Eaton Co., Toronto. Electrical work will be le

Burlington Steel Co., Ltd.
Hamilton, Canada

STEEL BARS
For
Concrete Reinforcing

THE MOST IMPORTANT FACTOR IN CONCRETE REINFORCEMENT IS THE TENSILE STRENGTH AND ELASTIC LIMIT OF THE REINFORCING BAR.

OTHER THINGS BEING EQUAL, STEEL HAVING THE HIGHEST ELASTIC LIMIT, OR YIELD POINT, WILL BE THE MOST SATISFACTORY FOR REINFORCEMENT. WHEN UNDER STRAIN, AS SOON AS THE ELASTIC LIMIT OF ANY REINFORCING BAR IS REACHED, THE METAL STRETCHES RAPIDLY DECREASING IN SECTION, DRAWING LOOSE FROM THE CONCRETE AND DESTROYING THE MONOLITHIC BOND EXISTING BEFORE THIS POINT IS REACHED THEREFORE, THE SAFETY OF THE ENTIRE CONSTRUCTION IS IN DIRECT PROPORTION TO THE ELASTIC LIMIT OF THE STEEL USED.

THE ELASTIC LIMIT OF RAIL CARBON STEEL IS 50,000 TO 60,000 POUNDS PER SQUARE INCH, EITHER TWISTED OR PLAIN, AS COMPARED WITH AN ELASTIC LIMIT OF 25,000 TO 30,000 POUNDS IN SOFT STEEL.

THAT'S WHY RAIL CARBON STEEL, WITH ITS 80,000 POUNDS MINIMUM TENSILE STRENGTH, IS RECOMMENDED AS BEING FAR SUPERIOR FOR ALL KINDS OF REINFORCED CONCRETE WORK.

AT OUR HAMILTON, ONT., WORKS WE BUY SELECT RAILS, AND ROLL THEM INTO RAIL CARBON STEEL REINFORCING BARS IN A PLANT WHICH IS THE EMBODIMENT OF THE LATEST THOUGHT AND PRACTICE.

THESE BARS CAN BE SUPPLIED FROM STOCK IN VARIOUS SIZES, LENGTHS AND SHAPES. WE CAN ALSO ROLL SPECIAL SHAPES AND SIZES TO FIT YOUR PARTICULAR REQUIREMENTS.

Bars bent to shape for Beams, Stirrups, Etc.

PROMPT SHIPMENT

Moncton, N.B.—C. W. Dobson, 1502 Main St., is building skating rink costing $50,000 to $60,000. Architect, John Ryan, Chatham, N.B. Electrical work will be let.

Montreal, Que.—Canadian Buttons, Ltd., 722 Visitation St., plan erection of factory to cost $50,000. Secretary, A. B. Stein.

Montreal, Que.—Montreal Warehousing Co., 234 Wellington St., will probably rebuild their warehouse, recently destroyed by fire with loss of $30,000.

Montreal, Que.—D. G. Loomis and Sons, 357 St. Catherine St. West, have general contract, masonry and carpentry for yard house costing $30,000 for Harbor Commissioners, 57 Common St. Balance of sub-trades will be let by commissioners. Chief engineer, F. W. Cowie.

Montreal, Que.—Quinlan, Robertson and Janin, 52 Duluth Building, have general contract and masonry for alteration of theatre into storage building costing $9,000 for Trust Realties, Ltd., McGill and Notre Dame Sts.

Montreal, Que.—Representatives of New York and Montreal capitalists waited on the City Commissioners and asked for permission to build a sixteen-story hotel at the corner of Peel and St. Catherine Sts. at a cost of $3,000,000. The Montreal capitalists behind the venture include Lord Shaughnessy and E. W. Beatty, of the C.P.R.

Moose Jaw, Sask.—Plans are under way for erection of a home and memorial hall for the G.W.V.A.

Norwood, Ont.—Erection of large hotel on Stoney Lake, directly north of Norwood, is planned by Mr. Winslow, of Cleveland, Ohio, and other prominent men of that city.

Olds, Alta.—McKercher Bros. plan to rebuild business block destroyed by fire with loss of $35,000.

Oshawa, Ont.—Williams Piano Co. will erect an addition to their factory.

Ottawa, Ont.—City council decided to submit by-laws to ratepayers as follows: $150,000 for fire hall, $300,000 for police station, $700,000 for memorial hall and $2,000,000 for a new city hall, courtroom and registry office.

Ottawa, Ont.—Salvation Army plans erection of hospital.

Ottawa, Ont.—Tenders addressed to R. C. Desrochers, secretary, Department of Public Works, Ottawa, will be received until 12 o'clock noon, Friday, December 12th, 1919, for the construction of a dairy building at the Experimental Farm, Ottawa. Plans and specification can be seen at the offices of the Chief Architect, Department of Public Works, Ottawa, and in the office of the Department of Public Works, Geodetic Survey Building, Central Experimental Farm, Ottawa.

Owen Sound, Ont.—Board of Education considering erection of Technical School.

Port Credit, Ont.—A solid brick building, 146 by 80 ft. and six stories high, is being erected by the St. Lawrence Starch Works.

Port Dover, Ont.—A new rink will be erected here. Clerk, James Sloan.

Port Dover, Ont.—G.T. Rly. will rebuild roundhouse, destroyed by fire, by day labor under supervision of Assistant Superintendent Chas. Forrester, London.

Prince Rupert, B.C.—Col. C. Peck, M.P., will leave shortly for Ottawa to press the city's claim for terminal facilities.

Prince Rupert, B.C.—Hays Creek has been chosen by the ratepayers as the site for the $150,000 school.

Quebec, Que.—J. A. Scott, 153 Grande Allee, let general contract for alterations to factory costing $11,000 to Alexander Fackey, 107 St. Joachim St.

Quebec, Que.—Magloire Cauchon, 307 Richardson St., has general contract for addition to factory costing $12,000 for Legace and Lepinay, 22 St. Anselme St. Architect, Wilfred Lacroix, 151½ Cartier Ave.

Red Mill, Que.—Canada Paint Co., 572 William St., Montreal, plan addition to plant. Superintendent, Frank Scott.

Regina, Sask.—Kitchener Hotel plans 80-room addition to hotel costing $50,000. Manager, F. Ufland.

Regina, Sask.—Tenders will be received up to December 14th by J. H. Puntin, architect, 308 Darke Block, on offices and creamery costing $250,000, also power-house and stack for Saskatchewan Co-operative Creamery Co.

Riviere du Loup, Que.—Banque Nationale, St. Peter St., Quebec, plans erection of bank. Architect, P. Levesque, 115 Jean St., Quebec.

Sherbrooke, Que.—Banque Nationale has purchased the Continental Hotel and will either repair it or erect a new building. Manager, A. E. Couet.

Sherbrooke, Que.—City council considering erection of business block on Wellington St. Mayor, Chas. D. White.

Sherbrooke, Que.—On December 17th ratepayers will vote on by-law granting exemption from municipal taxation to the Canadian Connecticut Cotton Mills and the Julius Kayser company's plant in view of the new plant extensions to be built by those industries. Approximate cost of Canadian Connecticut Cotton Mills' new plant, $1,500,000, and that of the Kayser Co., $200,000.

Standard, Alta.—United Farmers of Alberta plan erection of business block to cost $20,000.

St. Catharines, Ont.—Lincoln county council considering erection of soldiers' clubhouse.

St. Johns, Que.—Kenworthy Co., Stoughton, Mass., plan erection of factory and power-house.

St. Johns, Que.—General contract in connection with erection of addition to plant and office extension costing $25,000 for Canada Hart Accumulator Co. let to Anglin-Norcross, Ltd., 65 Victoria St., Montreal.

St. Johns, Que.—General contract for dry kilns costing $50,000 for Singer Manufacturing Co. let to Anglin-Norcross, Ltd., 65 Victoria St., Montreal.

St. Malachie, Que.—A large grain elevator owned by the Dorchester Co., Ltd., was recently destroyed by fire.

St. Thomas, Ont.—The erection of a new six-room school at the corner of Elm St. and Wilson Ave. will be undertaken immediately. Estimated cost, $75,000. Architect, Mr. Darrach.

Stratford, Ont.—J. Youngs, Birmingham St., has general contract for repairs to factory costing $10,000 for Canadian General Electric Co., 212 King St. West, Toronto.

Tillsonburg, Ont.—The special committee appointed in regard to a suitable soldiers' memorial for the town has recommended to the town council the erection of a community hall. The council accepted the recommendation, and a plebiscite on the question will be submitted to the ratepayers at the municipal elections.

Toronto, Ont.—Crane, Ltd., 88 Teraulay St., plan erection of factory costing $200,000.

Toronto, Ont.—The West St. Clair Y.M.C.A. Committee plan erection of "Y" building in Oakwood district.

Toronto, Ont.—Glidden Varnish Co., 382 Wallace Ave., plan erection of factory to cost $50,000. Manager, R. Higgins.

Toronto, Ont.—M. Parl, 137 Teraulay St., calls for tenders on all trades for warehouse costing $10,000. Architect, B. Swartz, 336 Dundas St. West.

Toronto, Ont.—J. L. Havill, architect, has prepared plans for gasoline station costing $15,000 for Imperial Oil Co., 56 Church St. Tenders will be called.

Toronto, Ont.—Plans have been filed in the city architect's department for a three-story concrete and brick factory to be erected by the Prest-O-Lite Co., Inc., of 120 Elm St. It is expected that work on the new structure will begin at the first of the year. The factory will cost $410,000.

Toronto, Ont.—The Willys-Overland Co. has been granted a permit to erect a reinforced concrete storage warehouse adjoining their motor car factory on the Westor Rd. at a cost of $30,000.

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Toronto, Ont.—The Works Committee of city council approved plans for the erection of a new Loew's Theatre on Yonge St., near Bloor. Another theatre plan passed was one for the Eastern Theatres, Ltd., for an amusement house on Victoria St.

Toronto, Ont.—Following building permits have been issued by City Architect's department: Toronto Housing Commission, 17 pairs semi-detached two-story brick and stucco dwellings, Annette St., corner of Spears, $104,000; Irvine Lumber Co., one-story open lumber shed, also addition to warehouse, 26 Vine St., $1,300; Harris Abattoir, automobile shed, west side of Symes Rd., near St. Clair, $3,000; Canadian Fairbanks-Morse Co., grinding and cleaning-room, 1383 Bloor St. West, $24,000.

Toronto, Ont.—Separate tenders addressed to T. L. Church (Mayor), chairman of the Board of Control, for the work included in the specifications of the several trades mentioned below in connection with the erection and completion of public lavatories will be received up to noon on Tuesday December 16th, 1919: (1) Mason work, (2) carpenter work, (3) metal work, (4) plumbing, (5) hot-water heating, (6) electric wiring and fixtures, (7) plastering, (8) painting and glazing. Plans and specifications may be seen at the office of the City Architect, city hall, Toronto.

Toronto, Ont.—The City Architect's department estimates that the city will enjoy a big building boom in 1920 to the extent of quite $24,000,000 worth of permits. The nearest approach to this figure was secured in 1912, when $27,000,000 was passed upon. Baldwins, Ltd., have filed plans for a $200,000 steel plate mill at Ashbridge's Bay. This is the first of a series of buildings for the firm. The total expenditure will be about $1,500,000. Dunlops, Ltd., are building a new factory at Queen and Booth Ave. to cost $450,000.

Vancouver, B.C.—Permit issued for erection of a new tire service station at 1301-1303 Granville St. for the Howard and Davis Tire Co. at cost of $10,000. Contract let to B. Davidson.

Vancouver, B.C.—Permit issued to Jules and Jay J. Allen, Toronto, for erection of new Allen Theatre, estimated to cost $300,000. Chief architect, C. Howard Crane, of Chicago, who has associated with him E. G. Kiehler. General contract has been let to Alex. McDonald, of Winnipeg, who has let a sub-contract for the excavation to A. B. Campbell, Vancouver.

Victoria, B.C.—Tenders are being called for by the Canadian National Ry. for the erection at the Songhees Reserve terminals of a five-stall engine-house and machine shop.

Walkerton, Ont.—Hanover Portland Cement Co., Hanover, Ont., plan to build quarry costing $200,000.

Walkerville, Ont.—Plans are under way for a memorial hall and clubhouse for the Ford and Walkerville branch of the Great War Veterans' Association.

Welland, Ont.—Brazil Motors Co., Brazil, Ind., plan erection of factory.

Welland, Ont.—Plans will be prepared for city council for erection of a combined market building and band hall.

Westboro, Ont.—The Westboro and District Branch of the G.W.V.A. plan erection of hall.

Weston, Ont.—Weston branch, G.W.V.A., plan erection of clubhouse. President, R. H. McInnes.

Weyburn, Sask.—Saskatchewan Co-operative Creameries, Regina, plan erection of creamery and cold storage plant to cost $100,000. President, C. Paynter, Tantallon.

Wingham, Ont.—Contract for the woodwork let to W. H. Rintoul and for the brickwork to Mr. Brown in connection with erection of new Wingham Fair building. Estimated cost, $5,000.

Winnipeg, Man.—Construction will commence early in the spring on the first lignite manufacturing plant in western Canada, J. M. Leamy, Provincial Power Commissioner for Maintoba, announced last week. The plant will be located six miles south-east of Bienfait, Man., on a spur of the C.P.R. All the buildings will be of steel.

MISCELLANEOUS

Barton Tp., Ont.—By-law to provide $8,500 for purchase of a stone-crushing machine will be submitted to ratepayers at January elections.

Ottawa, Ont.—Contract let to W. G. Edge, Ltd., Ottawa, for $24,984 for supply of kitchen equipment for Parliament Buildings.

Ottawa, Ont.—The following are among the companies recently incorporated: The Oakoal Co. of Canada, Ltd., Toronto, capital $1,250,000; Gear Produce of Canada, Ltd., St. Catharines, Ont., capital $250,000; Western Wheel and Foundries, Ltd., St. Boniface, Man., capital $2,000,000; Canadian MacArthur Concrete Pile Co., Ltd., Montreal, capital $24,000; Charles E. Goad Engineering Co., Ltd., Toronto, capital $300,000; MacPherson Wire Co., Ltd., Hamilton, capital $400,000; Canadian Inspection and Testing Co., Ltd., Toronto, capital $40,000.

Petit Rocher, N.B.—Dominion Department Public Works let contract to Thos. P. Charlton, 179 Gilmour St., Ottawa, for repairs to breakwater.

Port Arthur, Ont.—The Federal Mining Co. has been incorporated with a capitalization of $40,000, the officers being F. S. Wiley, G. C. Gibbs and W. D. B. Turville.

Regina, Sask.—W. F. L. Edwards proposes to erect a dance pavilion at Wascana Lake at a cost of $20,000.

Sarnia, Ont.—Lambton county council is considering the purchase of stone-crushers.

Smith's Falls, Ont.—Town council decided to submit two by-laws to the people at the elections in January, one to grant certain concessions to the Canadian Cooperage Co., which intends to establish a new plant here, and the other to raise $25,000 for the erection of a new fire hall and the purchase of a chemical motor engine and hose truck and other equipment.

Ste. Famille, Que.—Contract let by Dominion Department Public Works to O. Poliquin, Portneuf, Que., for repairs to wharf.

St. John, N.B.—Mayor Hayes announced that he had been assured that the new drydock in Courtenay Bay, which will be the largest in the world, will be completed in two and a half years.

St. John, N.B.—A deputation composed of Senator W. H. Thorne, Brig.-Gen. H. H. McLean, M.P., and R. W. Wigmore, M.P., have gone to Ottawa to urge the government to proceed with improvements already planned for the port of St. John. The work the deputation wishes to see undertaken is quite apart from the Courtenay Bay development scheme. The delegation will also urge the government to proceed with the plan to make St. John a national port under the control of a harbor commission.

Sydney, N.S.—An expenditure of over half a million dollars is to be made by the Dominion government at Sydney in the preliminary work in connection with the construction of the new terminal facilities for this port. Mr. Gregory, an official of the survey staff at Ottawa, is at present in the city taking some necessary soundings near the old government wharf and running some levels in the vicinity of Victoria Park. The department at Ottawa have practically all the necessary data on hand for the construction of the terminals and it is expected that tenders will be called for shortly for the work to be done. The government has already set aside in the estimates $100,000 for the erection of a new wharf. The construction of railway facilities will involve an additional expenditure of four or five hundred thousand dollars.

Toronto, Ont.—The following companies have been incorporated: Machinery Supplies, Ltd., head office at Toronto, caiptal $40,000; Hudson-Porcupine Gold Mines, Ltd., head office at Toronto, capital $1,500,000.

Vancouver, B.C.—A number of recommendations for the improvement of Vancouver harbor were made by the Vancouver Board of Harbor Commissioners at an interview with Hon. C. C. Ballantyne, Minister of Marine, Ottawa.

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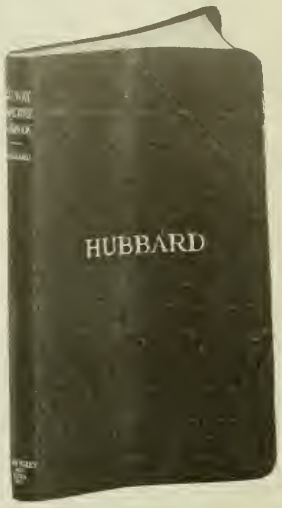
Highway Inspectors' Handbook



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They include the construction of a modern 1,300-foot wharf on Burrard Inlet, the institution of a car-ferry service to connect North Vancouver with Vancouver, and the construction of a terminal railway system. The improvements will probably cost several millions. It is understood that the Minister of Marine regards the proposals of the commissioners favorably.

Vancouver, B.C.—Tenders are being called up to December 29th by the C.P.R. for the dredging and filling work for the new "B" and "C" piers which the company is going to build in Burrard Inlet. It is expected that this work will take from seven to ten months to complete, and will cost about $500,000. The exact style of the new dock has not yet been decided upon, but the total cost will run into several millions of dollars.

Victoria, B.C.—New companies recently incorporated include the following: The Temple Contracting Co., Ltd., $10,000, Vancouver; British American Smelting Co., Ltd., $1,000,000, Vancouver; Co-operative Building Co., Ltd., $100,000 Vancouver; Canadian Adjustable Double Dock Co., Ltd., $500,000, Vancouver.

Winnipeg, Man.—The Hudson Mines have been incorporated with a capitalization of $5,000,000. The promoters of the company are H. R. McTavish, J. C. Finn, N. McTavish and E. B. Baldwinson.

Tenders Called For

YORK TOWNSHIP

Sealed tenders will be received by the Council of the York Township up to noon on Saturday, 17th January, 1920, for each of the following contracts:—

5,000 lengths 6-inch cast-iron pipes, more or less.
1,000 " 12-inch cast-iron pipes, more or less.
1,000 " 16-inch cast-iron pipes, more or less.
500 tons (about) 6-inch, 12-inch and 16-inch cast-iron specials.
200 6-inch gate valves, more or less.
30 12-inch gate valves, more or less.
20 16-inch gate valves, more or less.
250 hydrants, more or less.
250 round cast-iron valve covers and frames, more or less.

Specifications, forms of tender and further information may be obtained on application to the undersigned.

The lowest or any tender will not necessarily be accepted. The Council may divide the contracts as they may deem expedient.

All envelopes must be plainly marked on outside what tenders they contain, and they must be addressed to—

FRANK BARBER,
Township Engineer,
40 Jarvis St., Toronto.

December 3rd, 1919. 386

Steam Turbine Driven Turbo-Blower Set

With Condensing Plant. For quick delivery from stock at very favorable price.

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FOR SALE.—Fourteen-inch three-screw Dumpy level. In perfect condition. Only used a very short time. Box 39, *Canadian Engineer*, Toronto.

FOR SALE.—Twenty-one bound volumes of the Engineering Magazine, 1893 to 1905; twelve bound volumes of Engineering, of London, Eng., 1898 to 1903. Will sell separately or en bloc. Write, making offer, to Box 31, *Canadian Engineer*, Toronto.

MANUFACTURER in Eastern Townships, having good facilities and considerable experience in the production of a wide variety of machinery lines, desires to undertake the manufacture (for the Canadian or export trade) of American or English machinery. Full particulars gladly upon request. Box 396, *Canadian Engineer*, Toronto.

FOR SALE.—1,100 h.p. Laval Steam Turbine and Generator; Worthington Centrifugal Pumps, Capacity 1,500 g.p.m.; Sturtevant Exhausters and Heating Coils; Cypress Tanks and Vats, all sizes; 100,000-Gallon Cypress Tank on 70-ft. Steel Tower; Steel Tanks, 20 ft. diam., 20 ft. height; Valves, Hydrants, Indicator Posts, etc. Write for full information and list of material to St. John Dry Dock and Shipbuilding Co., Drummondville, Que. 384

PATENT NOTICE.—Any one desiring to obtain the invention covered by Canadian Patent No. 179,900, granted on October 23rd, 1917, to Edward J. Falkner, of Wellington, New Zealand, for Receptacle Filler and Measure, may do so upon application to the undersigned, who are prepared to supply all reasonable demands on the part of the public for the invention and from whom full information may be received. Fetherstonhaugh & Co., 5 Elgin Street, Ottawa, Canada. Russel S. Smart, resident. 387

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AUSTIN CUBE OR KOEHRING PREFERRED

State size, location and length of time in use .

Box 35, The Canadian Engineer
TORONTO

A resolution, requesting the Ontario government to enact legislation providing that the term of office of the Hydro-Electric Power Commissioners shall be for not less than six years was recently introduced in the Toronto city council.

The Canadian Engineer

A Weekly Paper for Civil Engineers and Contractors

Proposed Development of Hamilton Harbor

Report Presented This Week to Hamilton Harbor Commission, Recommending Creation of 1,250 Acres of Park and Residential Property, 1,198 Acres of Industrial Land, 6.26 Miles of Docks and 16.98 Miles of Boulevard

By JOHN M. WILSON
District Engineer, Public Works Department of Canada

HAMILTON harbor, situated at the westerly end of Lake Ontario, possesses natural advantages that are not surpassed by any other harbor on the Great Lakes. Its present area at normal Lake Ontario level (elevation 246 above mean sea level, New York), is 6,973 acres, varying in depth from shallow water in the marshes to 80 ft. in the harbor proper. Of this total area, 4,500 acres has an existing governing depth of 18 ft., or sufficient to take care of present Welland canal draught. The harbor is land-locked with the exception of a channel (maintained by the Dominion government) at the entrance to Lake Ontario, and has a normal shore line of 32.78 miles.

A casual reference to the plan showing the existing conditions (see page 538), and consideration of same in reference to the size of the city of Hamilton, conveys the impression that complete development of Hamilton harbor involves a cost disproportionate to the size and needs of the community affected. This was taken into consideration during the early stages of the investigation into the possibilities of Hamilton harbor, and it was thought wise to make the proposals as complete as possible, looking to the future growth of the city. The work projected on the plan on page 539 may not be completed for a number of years, but if the scheme as a whole be adopted, the foundation will have been laid for continuity in planning construction operations to be undertaken from year to year as finances will permit.

In the year 1873 the population of Hamilton was 30,000; the (municipal) census of 1919 gives a population of 110,000. Using the rate of growth shown by these figures, a curve might be projected into the future in order to determine the probable population at any given time, but I do not believe that any such estimate would be conclusive. Hamilton's location as a logical manufacturing and distributing centre should attract a large percentage of the immigration that I am reliably informed will shortly come to this country from the British Isles, and this, together with the natural development of Canada during the next few years, should greatly accelerate the city's growth.

Provides for 30-Ft. Draught

In planning for the future in works of this nature it is necessary to consider the requirements of a community many years in advance, and to take into account what the possibilities of an inland port situated as is Hamilton, will be when the St. Lawrence and Welland canals are deepened and ocean tonnage is brought to the Hamilton docks. I may say that a very strongly organized movement is now under way to bring about the deepening of the St. Lawrence canals, and Hamilton would particularly benefit on account of the very large export tonnage that would be handled over the harbor.

An essential to the successful development of a harbor, from an industrial and commercial standpoint, is public control of the waterfront properties. In this regard the Hamilton Harbor Commission is not in the position it should be. A large portion of the waterfront property is privately owned or controlled, and in order to put the commission in possession of assets that would form a sound basis for negotiation with private interests, and furnish lands for industrial development, it was deemed expedient to recommend the establishment of a new harbor headline in accordance with the limits of the work outlined on the development plan.

The scheme in general provides for ships drawing 30 ft. of water, or ultimate Welland canal draught, to dock in slips at the city of Hamilton and alongside wharves constructed in what is at present the waters of the harbor, and serving lands created by reclamation with material dredged and pumped from the bed of the harbor; the serving of these industrial lands with steam and electric transportation, concentrated on what is termed a marginal way; and the creation of new park lands and recreation centres, coupled up with a boulevard drive 16.98 miles long, encircling the entire waterfront.

Nineteen Tentative Plans Studied

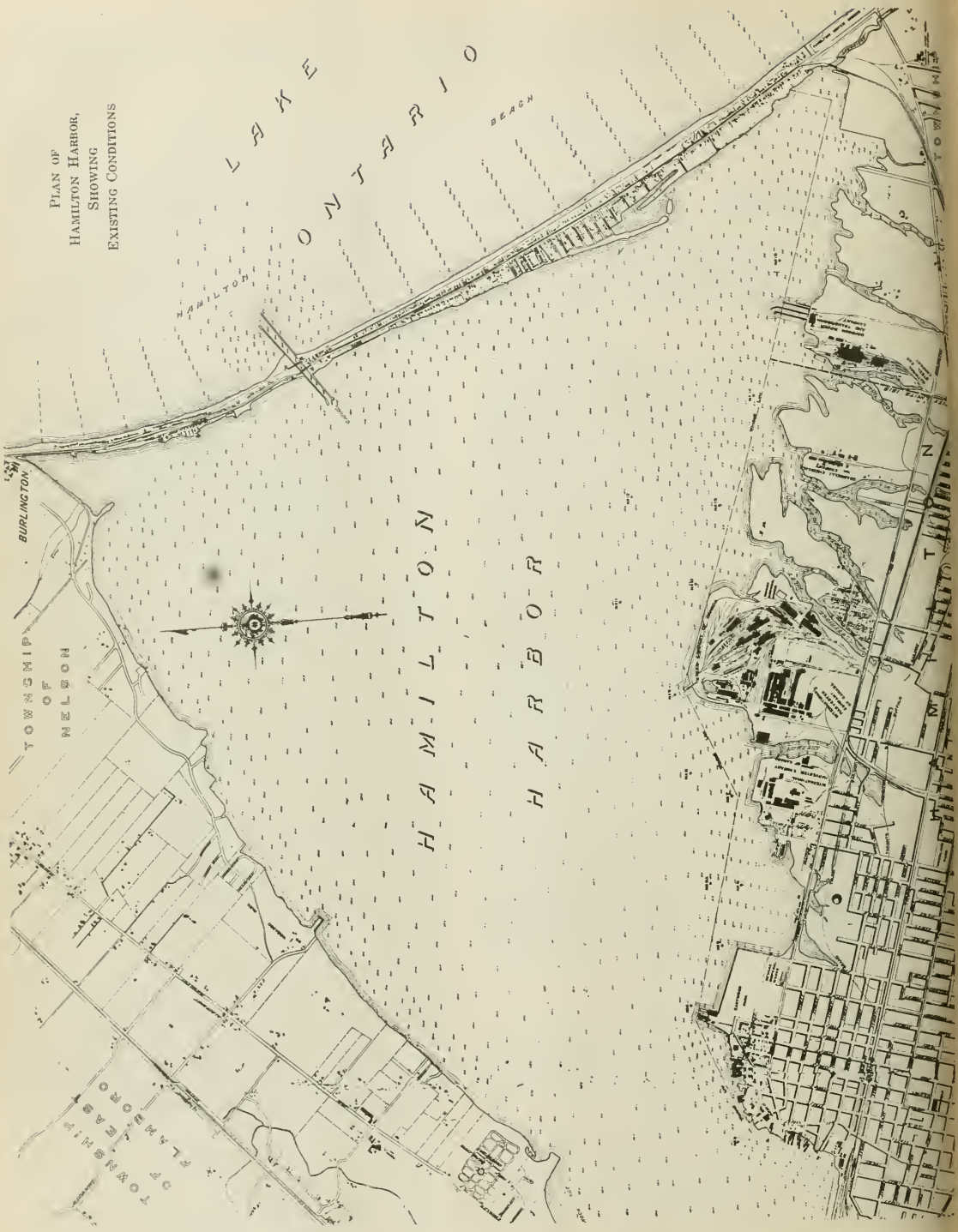
A complete survey of the harbor and vicinity has been made, soundings taken over the dredging and reclamation areas, and borings made to ascertain the nature of the material to be moved, and nineteen tentative study plans were prepared before the layout suggested herein was adopted.

The decision to concentrate to a large extent the industrial development to the east of James street was made after a careful study of existing conditions, embodying the natural advantages of the land in that section of the harbor, its accessibility to service, its adaptability to reclamation, and its relative ease of acquirement.

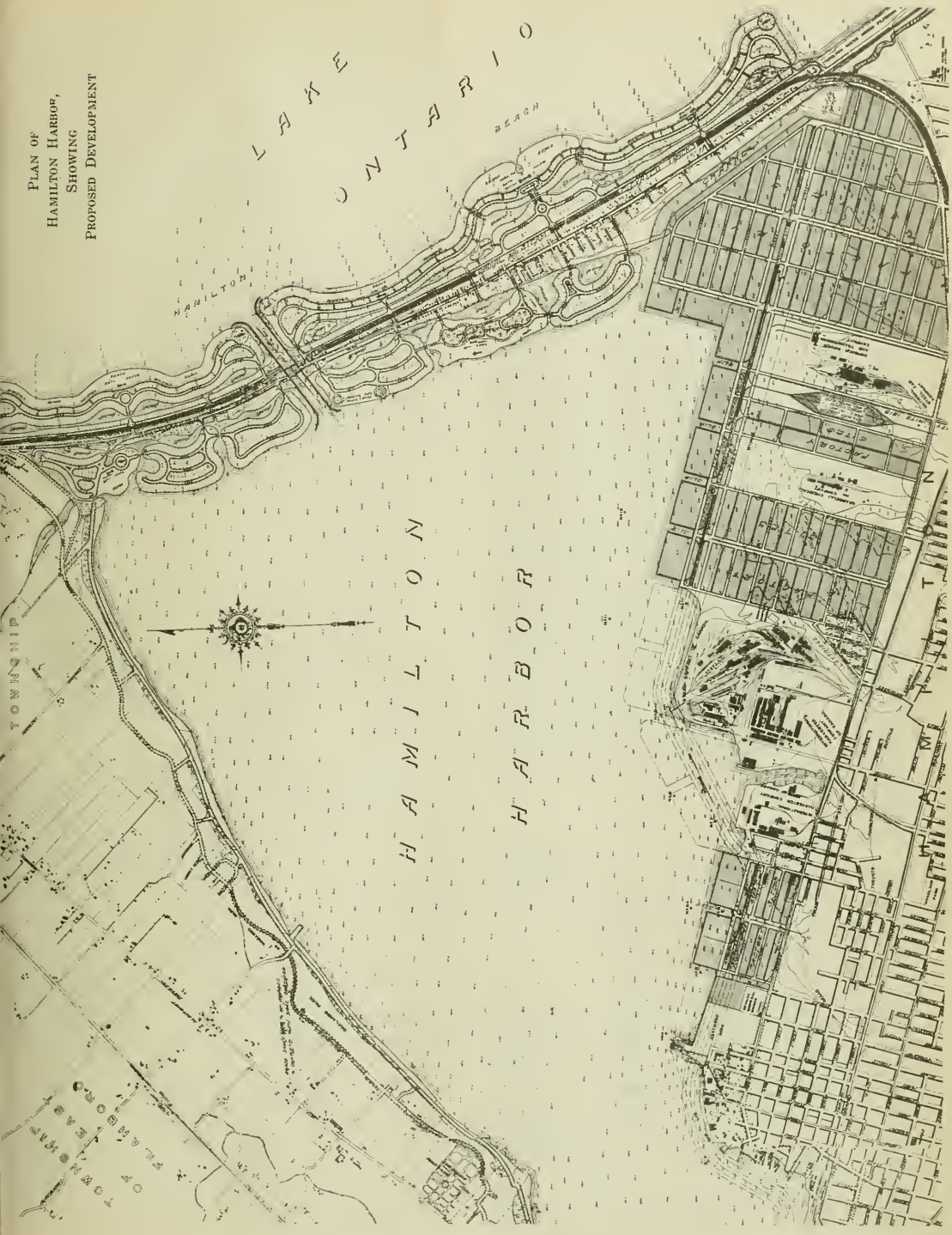
This industrial development is divided into two main districts: (1) The one lying south of Burlington street, between Wellington and Wentworth streets; and (2) the one lying within Gage avenue, Burlington street and Beach road.

This leaves the waterfront development of the property between Wentworth street and Gage avenue (where large industrial plants are now located), a matter for future consideration and negotiation. The latter property lends itself to incorporation in the general scheme, as shown dotted on the waterfront development plan, but its failure to be brought into the general scheme does not deprive the other districts of adequate transportation facilities, it being possible to render service from existing lines. There is also the possibility of extension to the west of Wellington street as far as the Desjardins canal, but it is not anticipated that anything in the nature of permanent works would be required beyond James street for many years, although it would seem desirable for the commission to acquire control of the property.

The area that it is proposed to develop industrially is shown in solid outline, hatched, on the waterfront development plan on page 539, and more particularly detailed on the sketch on pages 546 and 547, showing cross section at foot of


PLAN OF
HAMILTON HARBOR,
SHOWING
EXISTING CONDITIONS
LAKE ONTARIO
BEACH
HAMILTON
HAMILTON HARBOR
BURLINGTON
TOWNSHIP OF NELSON
TOWNSHIP OF FLAMBORO EAST

PLAN OF
HAMILTON HARBOR,
SHOWING
PROPOSED DEVELOPMENT



Wellington street. It comprises 6.26 miles of docks, having slips 600 ft. long and 200 ft. wide, enclosing an area of 1,198 acres. Of this total acreage, 311 acres are taken up with streets, trackage right-of-way, sorting and distributing yards for freight, etc., leaving a net area of 887 acres of leasing and revenue-producing property. This area and length of dock wall would be subject to variation depending on the number and location of slips that it might be desirable to construct in order to provide the required accommodation for prospective industries.

The areas lying to the north of the marginal way are for the accommodation of plants requiring rail and dockage facilities immediately adjacent to their buildings, while the

(Continued on page 545)

$2,357,000 SEWERAGE SCHEME RECOMMENDED FOR EASTERN PART OF YORK TOWNSHIP, ONT.

YORK township, Ontario, is a district extending along the northern frontier of the city of Toronto from Scarboro on the east to the Humber river on the west, a distance of about fifteen miles. Its populated area varies from a depth of half a mile to three miles from the city limits of Toronto. The township council have desired for some time past to provide sewers for the more thickly settled parts of the district, and isolated schemes had been prepared, but when application was made to the city of Toronto for outfall facilities, the city authorities pointed out that it would be desirable to have a comphehensive scheme prepared so as to enable both the township and the city to know where all the main outlets would be located.

When the matter came before the Ontario Railways and Municipal Board, it was firally agreed that the township council would authorize the preparation of a comprehensive scheme of sewerage.

Frank Barber, as township engineer, and R. O. Wynne-Roberts, who is associated with him, were instructed to make the necessary investigations and to prepare a preliminary scheme. These engineers have now presented their report and preliminary plans covering their recommendations regarding the eastern division of York township, and other reports and plans will be submitted in the near future, dealing with the western division and with the district known as Runnymede and Swansea. It will require several years to carry out these schemes in their entirety, but they are so designed that the township council may authorize the construction of any section at any time, and when the system is completed all the sections will fit into the general system and be economical of operation.

The eastern division is bounded on the east by the Scarboro township limits, on the west by the Don river, on the south by the city of Toronto and on the north by Don Mills road, Glebe road and the Canadian National Railway tracks. The division is subdivided into two acres, east and west of Woodbine heights, called Woodbine and Todmorden, respectively, the former having an area of some 400 acres, and the latter about 1,000 acres.

Different sites for sewage disposal works have been considered in their relations to the most economical schemes, and three main sites are reported upon, namely: (1) The brickyard site, located on land adjoining the Don Valley Brick Works; (2) the St. Clair site, on Don Mills road, north of the C.N.R. line; and (3) a site in the Woodbine district.

The report, dealing in outline with three possible schemes, defined as Scheme C, Scheme E, and Scheme CE, is in part as follows:—

Scheme C

Scheme C provides for a combined system of sewers for the entire eastern division, with the outfall works at the St. Clair site. The trunk sewers in this scheme would, in Woodbine district, be along Rosevear, Barrington, Valley, Lumsden, Cedarvale, Bracebridge, Woodbine and the street north of Plains road to Leslie; and in the Todmorden district, along Sammon, Cronyn, Davies Estate, Mortimer, McCash, Cosburn and the corresponding streets west of Leslie street. The main trunk would be along Leslie street to the St. Clair site.

This scheme would cost approximately as follows:—

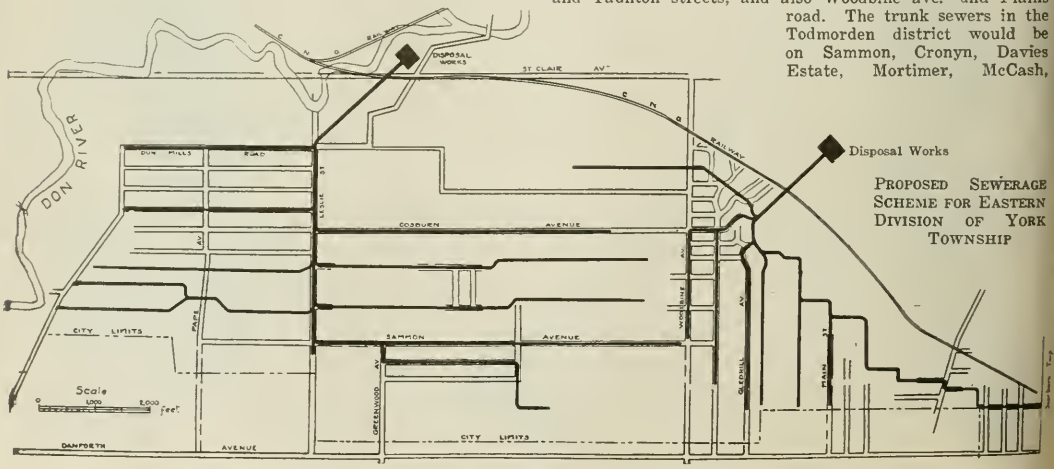
Woodbine—		
Trunks	$ 462,000	
Laterals	311,000	
		$ 773,000
Todmorden—		
Trunks	$1,176,000	
Laterals	488,000	
		$1,664,000
Disposal works		400,000
Total		$2,837,000

In this scheme the sewers are large enough to convey the entire flood water and sewage without relief. If relief sewers were provided, the cost of which would be deferred for many years, then the above total might be reduced by, say, $300,000.

Scheme E

Scheme E comprises two disposal works, one at Woodbine site and the other at the brickyard site.

The trunk sewers in the Woodbine district would be along Rosevear, Barrington, Lumsden, Westlake, Gresham and Taunton streets, and also Woodbine ave. and Plains road. The trunk sewers in the Todmorden district would be on Sammon, Cronyn, Davies Estate, Mortimer, McCash,



PROPOSED SEWERAGE SCHEME FOR EASTERN DIVISION OF YORK TOWNSHIP

Gower, Cosburn and Gamble, Plains road and Don Mills road.

This scheme would cost approximately as follows:—

Woodbine—		
Trunks	$ 289,000	
Laterals	264,000	
Disposal works	140,000	
		$ 693,000
Todmorden—		
Trunks	$ 991,000	
Laterals	40,000	
	380,000	
Disposal works	300,000	
		1,711,000
Total		$2,404,000

The above costs do not include relief sewers, which will parallel the trunk sewers and can be built when the streets are about to be paved and when the existing trunk sewers are working to their full capacities. It is not anticipated that relief sewers will be necessary for many years after the original ones have been constructed.

Scheme CE

Scheme CE would provide a sewerage system with two outfall works, one at the Woodbine site, and the other at the St. Clair site. The trunk sewers in the Woodbine district would be the same as already described in Scheme E, and the trunk sewers in the Todmorden district will be the same as described in Scheme C.

The cost of this scheme is estimated as follows:—

Woodbine—		
Trunks	$ 289,000	
Laterals	264,000	
Disposal works	140,000	
		$ 693,000
Todmorden—		
Trunks	$1,176,000	
Less relief sewers	142,000	
		1,034,000
Laterals	488,000	
Less relief sewers	158,000	
		330,000
Disposal works		300,000
Total		$2,357,000

In Scheme CE, the present savings which would be effected by providing future relief sewers are deducted so as to make a fair comparison with Scheme E, and it will be observed that these two schemes will cost about the same amount.

If the area south of Sammon avenue, be drained to the city, as the engineers think it should, then it will be possible to effect a tangible reduction in the cost of the remainder of the entire schemes. In view of the fact that the proposed schemes will dispose of sewage and storm water, and will thus relieve the city of the future disposal of storm water from the major part of the eastern division, it is recommended that the city be asked to deal with both sewage and storm water from the area south of Sammon and Cronyn avenues. It is also recommended that the subdivision of Davies Estate, adjoining Don Mills road and Cambridge avenue, be drained into the city sewers, for the reason that such method would be cheaper than connecting to the township sewers. The outlets can be arranged to suit city arrangement of sewers.

The engineers point out that in Scheme E, practically the whole of the sections west of Leslie street can be sewered without building the trunk sewer, but the latter must be constructed before the sewers in this section are fully developed, or the sections east of Leslie street can be undertaken.

In Scheme CE, the Leslie street trunk sewer must be built first, because it would be the only outlet for the sewage and storm water. Attention is also drawn to the fact that the construction of any portion of the system may be undertaken provided the works commence at the outfall ends.

Approximate annual capital costs of the two schemes, E and CE, have been computed on the basis of repayment, in the case of trunk sewers and disposal works, at 6% in 30 years, and in the case of laterals under 27 ins. diameter at 6% in 10 years.

In Scheme E, the total fixed charges amount to $215,600 per annum, or, on a frontage basis, an annual average cost of 55 cents per foot. In Scheme CE, the fixed charges total $207,097, or an annual average cost of 52.8 cents per foot. A tangible saving is shown when the figures are based on 30-year debentures at 6% for all works. Scheme E then totals $174,330, or 44.5 cents per foot; and Scheme CE. $171,075, or 43.6 cents per foot.

For puposes of comparison, it is interesting to note that the annual cost of different sewers excluding trunk sewers, already constructed in the township, ranged from 23.6 cents per foot seven years ago, to 53.31 cents per foot in 1917.

In making their recommendations as to which is the best scheme to adopt, Messrs. Barber and Wynne-Roberts state:—

"The problem of selecting the scheme which will be best adapted for future extensions, depends upon what new subdivisions will be placed on the market and what transportation facilities are available in the near future. For example, if the land along Independent road be subdivided, and a street railway is extended thereto, it would be necessary to anticipate the needs of that locality, and consequently the St. Clair site would be suitable. Furthermore, when the subdivision north of the Canadian National railway and east and west of Davies road, calls for sewers, then the Woodbine site will probably be suitable for most of it.

Scheme CE is Recommended

"For immediate development, the brickyard site offers some advantages. The Scheme E is more flexible, and it is the more natural outlet, and is accessible. It is, however, unfortunate that it is so near the residential portion, but for immediate purposes, it would be the one we would recommend. On the other hand, having regard to the future extensions of the populated areas, which of necessity must tend toward the north, we are prepared to recommend Scheme CE.

"If the brickyard site of Scheme E be carried out, it would be suitable for the future subdivision of the 80 acres west of Davies Estate homestead, and also for the parts lying off Todmorden road, but in the event of St. Clair site being adopted, it would be necessary to have a small independent plant for these areas."

Since 1912, $635,000 have been expended on London's sewer system. The city engineer's plans call for an additional $250,000 for 1920.

The eighteenth annual convention of the Canadian National Clay Products Association will be held at the Prince George Hotel, Toronto, January 20th to 22nd, 1920.

The engineer's report to the Vancouver and District Sewerage Board, presented recently, shows that the total expenditure since the inception of the board has been $2,253,915.

The Modern Housing Corporation, 435 Woodward Ave., Detroit, Mich., which is a subsidiary of the General Motors Corporation, is contemplating a housing scheme in Ontario and would be glad to receive catalogues from manufacturers of building materials.

Among the papers read before the Canadian Mining Institute recently in Vancouver, B.C., was one by William E. Greenwalt, of Denver, on the application of his process of electrolytic smelting of copper ores. Mr. Greenwalt predicted that in the near future electro-metallurgical methods will be so well established in connection with the copper industry as to compete successfully with the present system of smelters. The chief advantages of the process would be the elimination of the high cost of shipping ore from the mine to the smelter.

PATROL MAINTENANCE ON HARD SURFACE ROADS

By J. S. Crandell
Consulting Engineer, General Tarvia Dept., The Barrett Co.

SOONER or later all main line highways will be patrolled by repair gangs whose business it will be to maintain the roads under their care in satisfactory condition. Probably this would have been done long ago except for the fact that it seemed like a needless expense to pay wages to men to keep up roads that were thought not to need upkeep. But from the beginning the railways knew the value of section gangs, and the secret of low operating cost is largely perfect maintenance of track. Highway engineers have to learn the lesson; some of them have already learned it, and have profited thereby.

There is not much use trying to repair and keep in good shape a road built of poor materials on undrained soil. But given a good road, it is a simple matter to keep it in perfect condition all the year round if a system of intelligent maintenance is installed. Under these conditions, a well-built road will last indefinitely. A splendid example of what can be accomplished is found in Lucas County, Ohio. The county surveyor, Cecil L. Rood, has reduced the cost of maintenance from year to year, in spite of higher prices for labor and materials.

Fig. 1—Patrol House for Storing Road Materials

There are several points to be borne in mind in maintenance work:—

1. Train the men for the work to be done.
2. Keep on hand an adequate supply of materials for maintenance.
3. Use labor-saving devices.
4. Provide shelter where men can work in bad weather.
5. Keep materials, tools and other equipment locked up when not in use.
6. Keep accurate records of all work done, with cost, time, materials, etc., included.
7. Get out on the job often and "stick around."

One of the best investments in starting a patrol maintenance system is the acquisition of a building in which material and equipment may be stored, and where men can work. Such a building is illustrated in Fig. 1. Here a mixing board has been placed on which Tarvia KP and stone are being mixed as a patching material. (The mix should be stored away for a few days before using.) In this patrol house are kept shovels, screens, brooms, pick axes, wheelbarrows, sledge hammers, lockers for the men, etc. The house is well ventilated, and on a rainy day two gangs of mixers may be kept busy mixing and storing away the patching material for future use.

Often an old house or shed may be acquired for a patrol house. A little repairing or painting will make it suitable and attractive. Nor is it necessary to provide new and expensive equipment throughout. Fig. 2 shows how a barrel of Tarvia KP has been mounted on an old fire hose truck that had been discarded years ago. For $2 it was made into an excellent vehicle for moving barrels from the yard to the job. Similar economies will occur to the observant foreman or engineer.

Fig. 2—This Rig Cost Just Two Dollars

If the mileage to be covered by a patrol gang is extensive, it will be cheaper to buy a one or two-ton motor truck than to haul with horses. The wages saved by reducing time lost getting to and from the job will soon pay for the truck.

Many cities and counties are keeping their supply of bituminous patching materials in storage tanks. A convenient form for town or city plants is shown in Fig. 3. If the tank is to be used along country roads, it is better to place it with the long axis horizontal instead of vertical, and to elevate the tank sufficiently so that the cold patching material may flow by gravity into the wagons or trucks that the maintenance gang uses. Such a tank is inexpensive; about $150 for a tank holding 1,200 gallons is a fair price. The advantage far outweighs the initial cost.

Fig. 4 shows a convenient form of wagon for bringing the mix from the patrol house to the job. The one illustrated is a cart used formerly for collecting ashes and garbage. A bottom dump wagon is not so handy a type for this kind of work.

Fig. 3—Inexpensive Municipal Storage Tank

Much of the repair work has been done in the past with hot bituminous material. The cold patching products now on the market offer a great range of usefulness, and require less care and equipment. When a hot patch is to be made, the patrol gang must be provided with a suitable portable kettle for heating the tar, and with fuel sufficient for the day's work. "Cold patch" requires neither of these.

In using a tar cold patching material, several points should be observed:—

Don't use wet stone; don't use dirty stone; don't use too much tar (about 12 to 15 gals. of tar to the cubic yard of stone is about right); don't leave a freshly made patch of stone and tar uncovered in the rain (in wet weather it should be protected for a day); don't heat a tar cold patching material (if heat is necessary, warm the stone instead).

Mix one cubic yard of a mixture of one part coarse clean sand and three parts of ¾-in. stone, with 12 to 15 gals. of tar. Mix tar and stone first, then add sand. Let this mixture cure, or season, for a few days before using.

Clean out the hole to be patched; paint the sides of the hole with tar; deposit the mixture in the hole and tamp well; leave the patch slightly higher than the surrounding road metal (it will settle after a while); sand the top.

When the patch has set up hard, sweep it and give it a light seal coat of tar, and cover with sand or screenings. Do the painting with a brush. Do not pour a bucketful of tar on a patch; only a very light coat is required.

FIG. 4—PAINTING BOTTOM AND SIDES OF HOLE

Traffic will iron out the patch into a smooth surface. Some engineers prefer to use only tar and stone, with no sand. If the stone contains much fine material, the result will be satisfactory, but with a graded stone from ½-in. to 1¼-in., and no fines, the mix will be too open to make a good patch, and sand is necessary.

The value of training the patrol gang cannot be overestimated. Get them to do the work right from the start and much worry and trouble is eliminated.

And patch! Patch *every* hole, large or small. The earlier you can catch them, the less there is to do. Patch breaks in bituminous or cement-concrete surfaces as soon as they appear. Often a paint coat of tar with a coating of clean chips or gravel will prevent the formation of a hole.

Be sure to clean thoroughly the surface to be painted. Don't attempt to apply tar to a dusty, mud-caked pavement, for the tar will not stick, nor will it retain its characteristic properties. By using care and judgment, skin patches of considerable area and thickness may be built up. Use clean stone chips or ½-in. gravel for covering material instead of sand, because sand is likely to cause the material in the patch to wave or bunch; chips or gravel prevent this.

Follow up every complaint; determine the cause, and supply the remedy then and there.

Patrol maintenance means perfect roads every day of the year. It means lowered cost of maintenance. It also means putting off reconstruction indefinitely, and that means lower taxes.

TORONTO'S MARGINAL BOULEVARD

By Reginald B. Evans
Engineer of City Parks, Toronto, Ont.

FOR some years a survey has been under way for a marginal boulevard surrounding the city of Toronto. Plans and profiles have been plotted, costs of grading estimated, some work done along the south or lake-front side, and three miles of road built along the west margin of the city up the picturesque valley of the Humber river.

The latter section is much used by automobiles, as it connects the Hamilton highway with Dundas street and lies

A PICTURESQUE PART OF THE BOULEVARD

through more than one hundred acres of park land owned by the city. This part of the boulevard has grown from an early trail used by our forefathers to carry grain from Lake Ontario to the old mill at Bloor street on the Humber river.

The first pavement was laid some ten years ago of concrete and is still in good repair, although it has been widened from 16 ft. to 30 ft. The road from the lake to Bloor street for the most part follows the top of the ridge of land lying between the Humber river and the ravine to the east. Little or no drainage was required on this part; some heavy clay cuts were made, however, and for several years trouble was experienced in these from heaving with frost and flooding. Finally weeping tiles were put along the side of the road and no difficulty has arisen since.

Where the road descends into the valley, a 5½% grade is used for 1,300 ft. This hill is not paved with concrete but with tar macadam, as are all the steep hills. At Bloor street the boulevard crosses the Humber river on a hand-

HUMBER SECTION OF BOULEVARD DURING CONSTRUCTION

some stone bridge built jointly by the county of York and the city of Toronto. This point is about one and a half miles from the lake and is the head of navigation for small boats. During the summer and well on into October, canoes ply this river in great numbers and small boys bathe along its shores.

On the west bank of the river, space is provided for parking automobiles, and a commodious tearoom is open the year round. The road from there north follows the west bank of the river, and in places is cut out of the high bank, where springs of water and seepage had to be taken care of by drains and ditches. For a distance of several hundred feet, the only location for the roadway was through a swampy piece of land at the foot of a hill. To get a foundation it was found necessary to lay weeping tile along the west side of the road, next to the hill, and to fill over the swamp high enough to get the road up out of the wet. The drain pipe is about three feet below the surface, and runs both ways from the summit. The swamp probably has fairly well dried out since construction some five years ago, and no trouble has been experienced. From this point north as far as Dundas street, the road is finished but no planting has been done, the scenery along the river being the principal charm.

From Dundas street the survey follows the Humber river and Black creek to the point where this creek goes under the Grand Trunk railway's northern division. This valley is laid out in golf grounds, market gardens and

Boulevards are Profitable When They Bring This Nearer to Kiddies of Crowded Cities

farms. The side hills are well wooded and a road is needed to develop the growing suburb.

From the Grand Trunk the proposed boulevard follows an 86-ft. diagonal road in a northeasterly direction to the corner of Dufferin street and Lawrence avenue. This is part of the system of diagonal roads as laid out by the city surveyor, comprising a comprehensive scheme for the future of the city. This diagonal road system is followed for another mile and a half across level farm lands to where the boulevard route descends into the valley of the Don river. This section has been marked out by stone monuments for some five years, and all real estate plans are required to conform to it.

Following the Don river, the next mile brings the proposed road to Yonge street at York Mills, whence the drive can go down Yonge street for a mile to Hog's Hollow or follow the ravine a short distance west of Yonge. The west branch of the Don is followed through golf grounds and farm lands for about three miles to its junction with the main Don river. The scenery through this valley is beautiful, the road passing under the high Canadian Pacific Railway viaduct, where a special opening was made, during its recent reconstruction, at a cost to the city of about $6,000. This part of the drive could be easily constructed of gravel found along the route and later could be widened to accommodate future traffic.

From this point the route follows the valley of Silver creek to the eastern city limits, where it turns south to the Kingston road and thence via Woodbine avenue to the lake, joining the proposed Harbor Commissioners' road along the lake front to the Humber river.

The proposed marginal driveway is about forty miles in length, and approximately thirty miles are already secured to the city by present roads and promises of free rights-of-way 100 ft. wide through private property.

The alignment of the boulevard is made up of straight tangents and regular curves. The grade for the most part is light and conforms closely to the rise and fall of the ground.

The marginal boulevard is under the jurisdiction of Charles E. Chambers, commissioner of parks for the city of Toronto, while the southern, or lake-front link, referred to above as the Harbor Commissioners' road, will be constructed for the city by the Toronto Harbor Commission. A start was made this year on the first 8,000 ft. of the Harbor Commissioners' road, the construction being hot-mix asphaltic concrete on a cement-concrete base, 50 ft. wide.

THE TOWN PLAN AND THE FACTORY

By Louis Blake Duff
Welland, Ont.

ONE of the largest and best known industries in Ontario found it necessary a short time ago to provide for a considerable enlargement of its plant. One thinks of a plant enlargement as something added on to a building or set of buildings already existent. In this case, however, the new plant was separated from the old by over a mile. One day the whole works will be on the new site, for the old site has been filled to its edges. About it are substantial homes, some built before the factory, for the days of restrictions are comparatively young.

Conditions That Are Preventable

An analysis of this episode reveals the following set of conditions that a proper town plan would both prevent and foresee:—

1. The depreciation of the residential section due to (a) the elevation of factory buildings; (b) the frequent unsightliness of factory buildings, and in most cases the incongruity of the juxtaposition of factory and residence; (c) in certain cases smoke, fumes, noise and even dust.

2. The loss to the industrial interests of the community by the scrapping of old plant that is never quite fit for anything else, and the building of a new plant.

The factory area should have been located at the beginning of the town's growth, but the beginning has long gone past and the duty of this day remains to make the best of conditions in the laying out of areas that will serve the best interests of the community and of industry.

The areas chosen should be selected in their relation to (1) railway facilities; (2) water frontage, where necessary; (3) prevailing winds; (4) land available in large blocks, unbroken by streets; (5) accessibility; and (6) most important of all, the worker's home.

Locations, indeed, may vary. A plant making breakfast food differs in location requirements from a cement works. In general, decision as to location should be reached in the light of the greatest advantage to the city as a whole. New factories should be placed where they belong, whatever the temptation may be to place them where they do not belong; and there always are such temptations. Industries already wrongly placed should be encouraged to remove to their proper areas; there is always the incentive of added efficiency from proper location.

Industrial Land Often Subdivided

Some of our municipalities, among them Port Colborne in the Niagara section, have purchased areas for industrial development, a very necessary step to preserve the land from the subdivider. In not a few other cases, land admirably located for factories has been divided into lots. Some may be built upon and the others owned by people living in the four corners of the globe. The divided ownership, the enhancement of the values through speculation, and the broken

streets, shut the property out forever from industrial possibilities.

If the town plan, however, has some salvation to offer to industry, and nothing to offer to the worker in the industry, it has utterly failed of its mission. The factory system is here with its load of problems, one of which arises out of the fact that half the people of our nation are urban dwellers. The town plan should aid industries on the one hand, and on the other secure an economical land development, with comfortable houses and healthful living conditions for the workers.

This kind of home for every wage-earner can be made possible only by a full and frank recognition of how intimately the housing question is connected with other immense problems of town planning such as (1) factory location, to which reference has just been made; (2) street systems; (3) local transportation; (4) facilities for recreation; and (5) restrictions.

Town Plan Not Enough

But the town plan is not big enough to solve the whole problem. The regional plan, calling in the co-operation of a whole group of municipalities, is the only means by which waterfronts, the picturesque, and the historical, may be capitalized for the people. These vantage points of the section, under the regional plan, in a way become the property of all, and thought and care can make them of recreational service to all.

If the house in rental or in purchase price takes too large a percentage of the worker's wage, the deficiency must be made good by a reduced standard of living.

The builder of Port Sunlight advocated the buying of land by municipalities, to be given to those who would build homes for themselves. We have bonused every conceivable kind of industry, but no one has yet proposed the bonusing of homes. Yet the bonusing of a home is not so crack-brained as the bonusing of an industry. One bonus we can give, and that is the guarantee that the surroundings of every home will remain permanently good.

Thomas Adams, in a recent article on "Canada's Post-War Housing Progress," quotes the considered opinion of two well-informed observers as to the housing policy which has been adopted in this country, and which is not federal, provincial or municipal, but a combination of all three. C. Stanley Taylor, project engineer for the firm of Mann & MacNeille, New York, who were advisers to the United States government on many of their housing projects, states: "We wish to express our unqualified admiration for the completeness, practicability and simplicity of the administration methods of the Canadian plan.. We believe this to be the most practical step toward the provision of good housing by federal co-operation which has yet been taken in any country."

The city engineer of Edinburgh states that the Canadian project is on sounder economic lines than the proposed housing schemes in Britain.

K. V. Haymaker, of the Department of Labor, Washington, says that the difficulty in the way of more and better homes is financial. No solution short of a nation-wide solution is satisfactory. The house starvation of the nation cannot depend upon casual financing for alleviation. The local association, helpful as it has been, always falls down when its help is most needed.

"By-Products" of Good Housing

I mention these outside judgments because I believe we have started to answer the housing question on the right lines, and if we supplement the Housing Act in our own municipalities with provisions that will ensure to the home builder a non-impairment of his investment, and healthful and beautiful surroundings, we have gone a long way toward making our towns and cities fit places in which to live.

The fruits of the effort will not be good houses, alone, but, what is more important, good homes. Good homes make good towns and cities and good industries,—and out of it all will grow a good Canada.

For the young Canadian the gain will be more than for the old. The boys of Bournville at twelve years of age average 8½ lbs. heavier than those at St. Bartholomew's ward in Birmingham, and the girls a bit more than that again; and both boys and girls average nearly 3 ins. taller than those of St. Bartholomew's. The infant mortality rate is little more than half that of London.

A good house is more than a good house. It means also a good standard of living; it quickens the life, and it draws men and women, and little men and women, up to the light of better things. For what else do we live?

FOUR DAMS PROPOSED FOR ST. LAWRENCE RIVER

THE plans for the prospective development of the St. Lawrence-Great Lakes route for ocean navigation provide for four dams and concentration basins,—at Morrisburg, Cornwall, Lake St. Francis and below the Lachine Rapids. Extensive borings are now being made to determine the best sites. The first two dams would be international, and the others in the province of Quebec. It is stated that at least 3,000,000 h.p. could be developed. These dams would create a deep water channel between them for ocean vessels, but at each dam locks would be required as large as those being constructed on the new Welland Ship Canal, and near Montreal there would have to be a new canal system. Engineering problems which the Dominion Power Board is endeavoring to solve are the location of these dams so as to obviate ice-jams; extensive dyking against flooding of low-lying lands in Huntingdon county, Quebec; ascertaining the effect which the new plan, when completed, would have on the flow of the Ottawa River; and the fixing of a water velocity suitable both for navigation and power production.

PROPOSED DEVELOPMENT OF HAMILTON HARBOR

(Continued from page 540)

areas on the marginal way and to the south of it are for warehousing and light manufacturing where ready access to the water and shipping is desirable and rail shipment facilities are imperative. In the district to the south of the marginal way, all properties are served at the rear by trackage, leaving streets clear of obstructions for approaches and teaming.

The extreme easterly end of the district is served with a ship channel and turning basin, marking a clear-cut line between the industrial area and the beach development, as well as affording an increased area of waterfront property. Rail shipments in and out of the district are handled through a sorting yard, 58 acres in extent, located between Martimas street and Kenilworth avenue, and connected up with existing rail lines.

To carry out this proposal, certain properties would have to be acquired outright. In other cases, the commission could probably, by negotiation, arrange for a waiving of riparian rights in return for reclamation of water lots and docking privileges, but in any case it is not apparent where any serious obstructions would arise.

Coming to the question of cost, it is necessary to consider the length of time that would elapse before the entire work would be completed, and try to relate this in some way to the present uncertainty of labor conditions and costs of materials. Obviously this is quite impossible, as manufacturers will not quote prices except for immediate delivery and the wages paid to labor are constantly changing. A perusal of the price fluctuations during the past four years would show that an estimate made in 1914 would look absurd when applied to present conditions, and is sufficient evidence of what might happen during the next fifteen years, or the period of time over which the carrying out of this improvement might reasonably be expected to extend. In view of this, I thought it wise to recommend for immediate consideration the development of the industrial section between Wellington street and Wentworth street, for which the Dominion government has already made an initial appropriation of $100,000, and estimated the cost accordingly.

This area extends to the revetment wall at the foot of Wellington street, but the dock running north and south at that location could be left available for some time by allowing the reclamation material to take a natural slope on the westerly side, leaving the slip open. When conditions warrant (that is, when the area now set aside for a slip could be used to better advantage for manufacturing sites), the steel sheet piling forming the face of the government wall could be withdrawn and salvaged, thus minimizing the loss occasioned by abandoning the layout at present existing.

The main items entering into the cost of this section of the development are as follows:—

Construction of retaining wall	$ 980,000
Acquisition of property	103,000
Reclamation	933,500
Total	$2,016,500

This would put the commission in possession of an additional 97.07 acres of industrial property, exclusive of streets and track allowance, that could in the near future be utilized for factory and warehouse sites.

Burlington beach and the north shore of the harbor by their physiography lend themselves admirably to æsthetic treatment, and the proposed development along these frontages is largely for park, amusement and residential purposes. It might be argued that this phase of the proposal is not essential, but from a study of the prevailing conditions in other large centres, the writer is firmly convinced that no waterfront development is complete, or adequately meets the requirements of a large industrial city, if ample provision be not made for recreation purposes.

The sketch showing the typical cross section of the beach development (see illustration above), provides for the elimination of rail traffic on the beach road and concentrates power transmission lines and electric and steam roads on an elevated viaduct located approximately on the present Grand Trunk right-of-way. This viaduct could commence to rise on an easy grade in the vicinity of the Grand Trunk crossing at Burlington street, and the tracks could be elevated the entire length of the beach, striking the high ground and coming out on the level again in the vicinity of Brant House, Burlington. The elevation of these public services rids the beach of its objectionable features from the standpoint of a parking and playground treatment, permits free access to the lake beach from the boulevard drive, and may be incorporated in the layout proposed by the Tye-Cauchon report on the railway situation at Hamilton. The entire rail service accommodation suggested herein was planned with the probability in mind of the early electrification of steam roads in Hamilton.

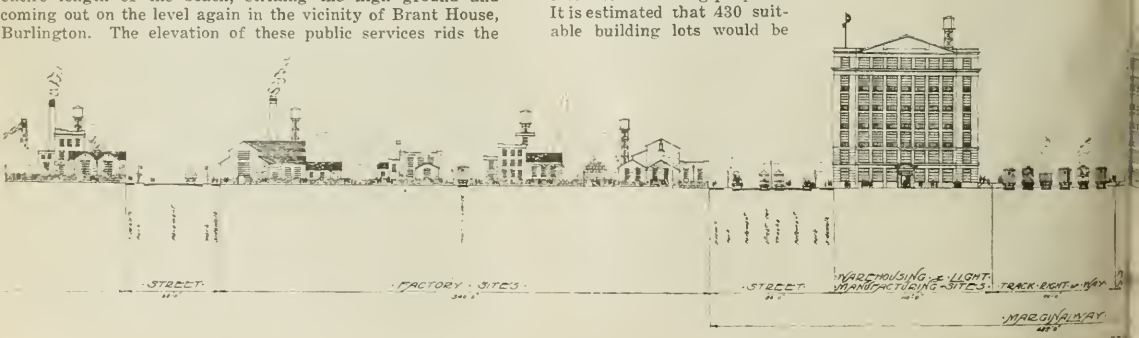
It was thought desirable to increase the beach area in order to provide greater accommodation, and soundings and borings revealed the presence of suitable material in sufficient quantity to more than effect the reclamation planned. A lagoon treatment is used along the frontages of the existing property, and the created lands are made accessible by artistic concrete foot bridges at strategical points and vehicular service bridges where required. Locations are suggested for bath houses, public parks, playgrounds, amusement centres, aquatic clubs and residences. There is also provision made for a promenade board-walk along the lake frontage of the beach, protected by a large sloping sand area extending to the water's edge.

Cross Section of Hamilton Beach in the Vici

Typical Cross Section of Hamilton Bea

It will be noted that no plans have been made for breakwater protection in the lake, it being impossible at this time to estimate the extent or location of the possible requirements. This can only be determined after careful observation of the effect of the waves and currents on the beach, after same has been reclaimed, but since the formation of Burlington beach is the result of a natural accretion, it is not expected that serious erosion will take place.

For the reasons outlined in connection with the industrial district, I estimated only the cost of the reclamation on the bay side of the beach to the south of the canal, which is the section that would in all probability be first undertaken. This comprises an additional area of 172 acres, 85 of which has been subdivided into lots for leasing purposes. It is estimated that 430 suitable building lots would be



Cross Section at the Foot of Wellington Street, H

available, allowing 50 ft. frontage to each, which, when coupled up with the returns from amusement privileges, should yield an annual income of approximately $75,000. The control of the present beach should be transferred to the Hamilton Harbor Commission before improvements are undertaken, so that the resulting revenues could be applied against the interest and sinking fund charges on the capital expenditure.

The items entering into the cost of this section of the development are as follows:—

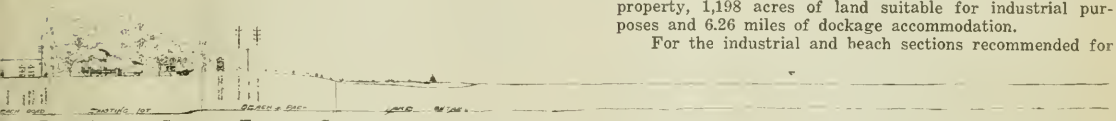
Reclamation	$1,486,000
Bridges	300,000
Channel wall at south end	700,000
Total	$2,486,000

the north side of the harbor over the right-of-way already largely dedicated, while the other section follows the water's edge on the parkway and beach to be reclaimed by hydraulic dredging at the foot of the cliffs. The two branches merge again at the west end of the harbor, where it is proposed to reclaim the low-lying marsh lands as another park area. The boulevard then continues along Harvey and Dundurn parks to connect through the city with Burlington street again.

The total length of this boulevard drive is 16.98 miles, 10.59 miles of which traverse parks or are over lands commanding a harbor outlook.

The completion of the entire work will leave Hamilton harbor with an area of 4,380 acres, or 6.8 square miles, having a governing depth for navigation of 30 ft., as compared with the present 4,500 acres, having a depth of 18 ft. There will be added 1,250 acres of park and residential property, 1,198 acres of land suitable for industrial purposes and 6.26 miles of dockage accommodation.

For the industrial and beach sections recommended for



RTH PARK AVENUE, SHOWING EXISTING CONDITIONS

COMPLETION OF PROPOSED DEVELOPMENT

The construction of roadways, sewers, water services, etc., would be taken care of in the cost as a local improvement, while the grade separation would be a matter of adjustment by the Board of Railway Commissioners between the city, the railway companies and any other interested parties.

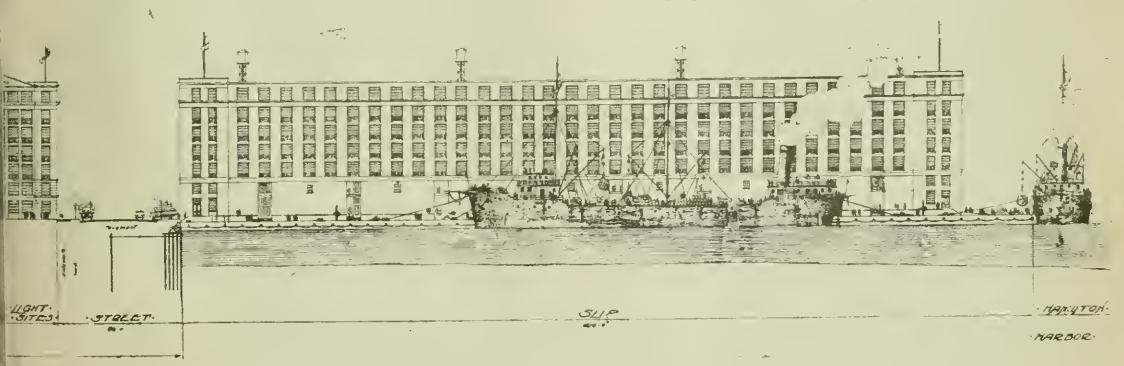
Burlington street, as before pointed out, forms the backbone of the industrial district, and through its connection with the east and west ends of Hamilton, is the logical connecting link for a boulevard drive around the harbor. This thoroughfare should be widened to 86 ft. and connected up at the east end with the beach road. The beach road, having been freed of rail traffic, carries the boulevard to the channel crossing, where the Dominion government has in contemplation the construction of a bascule bridge to span a 300-ft. opening instead of the present 150-ft. channel.

Continuing in a northerly direction along the beach road, the boulevard swings to the west near Brant House, where it divides. One section is carried along the high ground on

immediate consideration, the total estimated cost is $4,502,500 which should be apportioned among the parties interested—viz., the Dominion government, the city of Hamilton and the Hamilton Harbor Commission.

It has been intimated that the people of Hamilton would expect the Dominion government to bear the expense of the construction of the dock walls, at an estimated cost of $980,000, and to deed to the Hamilton Harbor Commission all water lots now vested in the Crown; also to pay the cost of the wall on the beach side of the channel and turning basin, which forms a part of the industrial district, at an approximate cost of $700,000.

The city of Hamilton should be asked to pay the cost of acquisition of all properties required, and to deed the same to the Hamilton Harbor Commission, at a cost of $103,000, and to pay for the reclamation of the park areas on the beach, at an estimated cost of $500,000. The city should also be asked to transfer to the commission all waterfront properties which the city now owns or controls.



HOWING TYPICAL PROPOSED INDUSTRIAL DEVELOPMENT

The Hamilton Harbor Commission would then have to finance the reclamation of the industrial areas and the revenue-producing section of the beach, including necessary bridges, at a cost of approximately $2,219,500.

This scheme would put the commission in possession of assets that would enable it to carry on the industrial development planned.

The length of time that it would take to see the entire undertaking completed depends entirely upon the financial support accorded it and the aggressiveness of the administration, but I have no doubt that if the work recommended for immediate consideration be gone on with now, the advantages that will result to the city of Hamilton and to the country as a whole, will commend themselves in such a way as to bring the entire scheme of waterfront and harbor development to an early realization.

Valuable services were rendered by J. E. Hollaman in conducting surveys and in the preparation of the plans, and consulting advice on parking and boulevard treatment by Jas. J. McKay. By the courtesy of the Toronto Harbor Commission, in order to obtain the benefit of their experience on their $25,000,000 waterfront improvement now under construction, it was possible to have E. L. Cousins, their chief engineer and manager, exercise a consulting supervision over the entire investigation.

PARRY SOUND WATER WORKS

Report by Consulting Engineers Favors Mill Lake as the Source of the Town's Future Water Supply—History of the Water Works

IN a report recently made by Chipman & Power, consulting engineers, Toronto, upon the proposed water works extensions and improvements at Parry Sound, Ont., a brief history of the original water works system and subsequent developments is related, present conditions are discussed, and recommendations are made regarding the best source of supply. The following information is abstracted from the report:—

The original system, designed in 1892 by John Galt for a population of 1,700 people, consisted of an intake pipe, pump house and residence for the operator, one steam pump, one boiler, an elevated storage tank and about five miles of distributing mains, with five hydrants and gate valves. The distribution system was extended year by year as demands arose. In 1904, a vertical triplex pump, driven by an electric motor, was installed, and in 1915 a larger elevated storage tank was erected beside the old one. The steel tank erected in 1892 is 16 ft. in diameter, 20 ft. in height, and contains 25,000 gals.; and that built in 1915 is 36 ft. in diameter, 18 ft. high, and has a capacity of 116,400 gals.

The present water supply is drawn from the harbor, and is polluted, as the Seguin river, which flows through the town, carries the sewage and street drainage into the harbor. The factories along the shore contribute to the pollution, particularly as the drainage from an iron smelting plant and a chemical works discharge within 300 yds. of the intake. The only purification of this water is effected by chlorination.

The present conditions are summarized as follows:—

1. The present water supply is polluted, and such pollution will probably increase.

2. The steam pumping plant is old and inefficient, and the pumping capacity must be increased.

3. A new pump house is required.

4. Distribution mains from the pumping station to the business section of the town are too small to give proper fire service.

The population of Parry Sound is now approximately 4,000, and the average daily water consumption for the entire year is estimated as about 300,000 gals., increasing in summer to a peak of 700,000 gals. per day, or the full capacity of the triplex pump. For a town of 4,000 population the fire underwriters require four fire streams, or about 800 gals. per min., which, added to the peak domestic supply, gives a total of 1,300 gals. per min. as the present requirements. In the opinion of the engineers, those portions of the works that cannot be extended or enlarged without the sacrifice of constructed works, should be of ample capacity for double the population, or for about 9,000 people. Upon this assumption, the normal domestic consumption would be about 700,000 gals. per day, the peak in the summer should not exceed 1,000 gals. per min., and the fire service required would be 1,400 gals. per min., making a total of 2,400 gals. per min. during fires.

Three Sources Considered

The engineers gave consideration to three sources of supply: (1) Parry sound; (2) Mill lake; and (3) Trout lake.

The area of the waters of Parry sound from Kill Bear Point to Rose Point, is approximately 24 sq. miles. The entrance to it from the west is navigable for vessels drawing 25 ft., and the sound itself could float the navies of the world. The maximum depth is 360 ft., this point being distant only two miles due west from the water works pump house, and one-third of a mile north of Three Mile Point on Parry island. The shores of the sound are of solid rock, with an occasional sand beach at the head of a bay. The Seguin river discharges into the south end of the sound, and along the north shore there emerge a few small brooks.

With the exception of the town of Parry Sound on the east, the Nobel explosive factory on the north, and the G.T.R. terminus of Depot Harbor on the south, the shores of Parry sound are uninhabited, and there is practically no agricultural land immediately back from the shore.

The entire population of the country along the shores of the sound, including the places above mentioned, at the present time does not exceed 5,000 people, and the town of Parry Sound, and the Nobel plant, are the only serious factors in the possible pollution of the water. The former is the only one that seriously affects the existing source of water supply.

At a distance of about half-a-mile due west from the water works pumping station, the depth of water is given on government chart as 210 ft. Intake pipes of greater length than this have been laid in Canada, but the engineers state that they do not know of any place in Canada or in the United States where a water works intake has been laid in a depth of water much exceeding 100 ft.

The bed of the sound is overlaid with a soft mud, that would bury any pipe laid along the bottom. It would be practicable to lay an intake with screen in 200 ft. depth of water, but it would be very expensive to repair such pipe if it should be accidentally broken or if it should draw apart at a joint. It could be tested at any time to determine if it had drawn apart, and it could be flushed out. Leaks, however, would be difficult to locate, and impossible to repair excepting by lifting the pipe above the surface of the ice in the winter months.

Pollution by Town's Sewage

At a depth of 200 ft. the temperature of the water would be lower than at the existing water works intake, and would therefore be less affected by warmer surface water during the summer months. When covered with ice, the water at the surface would be cooler, and it is probable that the general pollution would extend to the deepest points.

The location of the present pumping station was selected when the bay water was less polluted, and was undoubtedly the cheapest and best location when the cost of force main to the town is taken into consideration. To move the pumping station up the shore towards Bower's bay would involve a heavy expenditure for force main, as the excavation would be through solid rock for practically the entire distance.

The sewage from the town, now discharged into the Seguin river, is carried into the southerly part of the harbor and then, by the agency of currents and winds, the pollution is diffused. The engineers state that the greater the distance the intake be located from the mouth of the river, the less the degree of pollution. They are of opinion that the water from the present intake, or from an intake in that vicinity,

can be so purified by filtration, followed by chlorination, as to be safe for all domestic purposes.

If the harbor be retained as the source of supply, it will be necessary to treat the domestic sewage before discharging it into the river, and also to collect the sewage from a small, but important area near the pump house, and pump it over the hill to an outlet into sewers now flowing into the river. The first cost of the sewage disposal plant will depend upon the degree of purification necessary. Probably sedimentation tanks, and chlorine disinfection, will be considered satisfactory by the health authorities. The solids deposited in the tanks may amount to four tons per million gallons of sewage treated, all of which must be periodically removed and disposed of in some way. To collect the solids, and then discharge them into the river when it is in flood, would not give satisfactory results, but this might be done by an employee without the knowledge of the health officials, and the source of water supply seriously polluted. By chlorination, the bacteria in the sewage can be destroyed, but the dose must be a heavy one, say 50 to 100 lbs. of liquid chlorine for each million of gallons treated, or an average of about 35 lbs. per day.

Liquid Chlorine More Efficient

About 18 lbs. of hypo-chlorite of lime solution per million gals. are now used for sterilizing the water supply. Less than 3 lbs. of liquid chlorine would effect the same results as this quantity of lime. If hypo-chlorite of lime solution were used for disinfecting the sewage, it would require an average of 210 lbs. per day. The annual cost for chemicals for disinfecting the sewage, would therefore be about $6 a day, to which must be added the labor of attendants, say $1 a day, and the cost of the removal of the sludge. The total annual expense in connection with treating the sewage at the present time would amount to at least $3,000 per annum. Pumping the sewage from the area contiguous to the water works pumping station would cost about $600 per annum.

Mill lake is an expansion of the Seguin river, the outlet being distant 300 yds. from the north-east limit of the town. The lake is roughly circular, with an area of 1,100 acres. The Seguin river enters the lake from the north and discharges at the south-west angle. Another large stream enters the lake at the south-east angle.

The drainage area of the Seguin river above Mountain dam is given in a report of the Ontario Hydro-Electric Power Commission as 380 sq. miles. The annual run-off on this drainage area is given as 622 cu. ft. per sec., with a recorded minimum of 33 cu. ft. per sec., in September, 1917, and a maximum in April of 3,620 cu. ft. per sec. There is an additional area, tributary to Mill lake, which would increase the total to over 400 sq. miles. Practically all the land within the watershed consists of low ranges of solid rock, with swampy valleys between, which are scantily timbered. There are many lakes and ponds in the watershed, and at several points dams have been erected for controlling the water.

At the foot of Mill lake a timber dam was constructed many years ago, the height of the crest being 10 ft. above the slack water below. This dam raised the water in Mill lake about 8 ft., and flooded considerable low land from which the standing timber has been removed. The town has acquired this dam and other dams at various points on the river.

Fewer Dangerous Bacteria

On the main stream, about three miles north from Mill lake, another timber dam exists, called the Mountain dam, with a height of 25 ft., and on the south branch, one mile south of Mill lake, a dam 5 ft. in height controls the water. Another important dam is at the foot of Lake Waubeck. In all, there are about five substantial dams and several minor dams for controlling the water within the watershed, but none are being used directly for power purposes.

Early in the summer the lakes and ponds are full, and the dams overflowing. In the autumn and winter the stoplogs are removed and the water drawn down. In the early spring the lakes and ponds are refilled. Swampy areas have been flooded by these dams, and the water of the Seguin has consequently acquired a swampy taste that is disagreeable. In color the water is brown, similar to that in the Ottawa river. It will probably be found to be much softer than Parry sound water, say the consulting engineers, and therefore more satisfactory for laundries, bathing, boilers, etc.

Bacteriologically, the Mill lake water will probably show a greater number of bacteria, they say, but fewer dangerous bacteria of the typhoid group than does the present source of supply. Mill lake has an elevation of 52 ft. above Georgian Bay. A contract has been awarded for a new concrete dam to replace the old timber dam.

Filtration, Chlorination and Aeration

Filtration and chlorination will render this water safe for domestic purposes, and some of the color will be removed by the filters, but there may be some difficulty in removing the disagreeable taste. In some places this has been accomplished by aeration.

As compared with the water in Parry Sound, the water from Mill lake will be darker in color, warmer in summer, softer, but occasionally swampy in taste. It will also be a safer water from the public health standpoint. The engineers state that they cannot assume the responsibility of recommending the taking of the supply from the Seguin river below Mill lake, owing to the number of nuisances that now exist along the river bank, and the possibility of factories or buildings being erected that will drain into the river. This river bank could, however, be cleaned up, and as it is now owned by the government, it is probable that it could be protected from future pollution. The danger of sewage pollution from the Mill lake area may be considered as negligible, but in order to prevent contamination, a strict surveillance of the lake shore will be necessary, if it should be selected as the source of supply.

The size of the conduit necessary to convey the water from Mill lake to the pumping station at the power house will depend on the height at which the water in the lake is to be maintained. With a 24-in. conduit, the discharge at the pump house would be 1,630 gals. per min. with the water in the lake drawn down 7 ft. below the crest of Mill lake dam, 2,240 gals. if drawn down 5 ft., and 2,650 gals. if lowered 3 ft. The engineers are of opinion that the lake will seldom be lowered more than 5 ft. With this head, a 20-in. conduit would deliver 1,450 gals. per min., and an 18-in. pipe 1,100 gals. per min.

In the Mill lake scheme, by reducing the diameter of the conduit from 24 ins. to 18 ins., the capacity would be decreased by about one-half, and if Mill lake were drawn down a few feet, the discharge would not be sufficient for fire service, and it would then be necessary to supplement it by pumping from the power house fore-bay.

The engineers state, therefore, that they would not advise that the conduit be made less than 20 ins. in diameter. This will discharge 1,100 gals. per min., with Mill lake lowered 7 ft.

The Trout Lake Scheme

Trout lake is distant about two and one-half miles in a straight line north from Mill lake. The area of the lake is about 660 acres, and the area of its tributary watershed 1,340 acres, in addition to the lake surface. The greater part of the shore line is rock, and one sounding gave a depth of 45 ft. The water in this lake is clear, quite a contrast to the amber-colored waters of the Seguin river and Mill lake, and was found free from pollution.

The lake discharges normally to the southward, but in high water it overflows eastward through a ditch; both outlets eventually discharge into the Seguin river.

At the main outlet, the stream falls about 30 ft. in a distance of about a half-mile, entering a small pond. Leaving this, the water flows through a rocky canyon, with a fall of 140 ft. in less than a mile. The elevation of Trout lake is 250 ft. above Georgian Bay, and 40 ft. above the top of the existing steel water tank.

The length of gravity conduit necessary to convey Trout lake water to the power house would be about 32,000 ft., and about 5,000 ft. length additional main required from the

power house to the tank. If a 12-in. conduit were laid throughout, it would deliver about 1,000 gals. per min. at the power house, and 450 gals. per min. into the water tank. The discharge would be doubled by using a 16-in. conduit. A satisfactory domestic supply could be given for some years by gravity through a 12-in. conduit, but for fire service, pumping would be necessary. Should the domestic demand increase the peak above 500 gals. per min., it would be necessary to boost the pressure by pumping.

Gravity Type Filter Plant

If a 16-in. pipe were used, it would give domestic service without pumping for many years, but pumping would be necessary for fires and for domestic service whenever the peak demand exceeds 1,000 gals. per min., or at the rate of 1,440,000 gals. per day. The peak hourly domestic demand in the summer months is now about 600 gals. per min. and will increase with the population.

The quality of the water in Trout lake is satisfactory, and its elevation sufficient to give a domestic service by gravity. The clearness of the water is due to the small watershed as compared with the lake surface, and the rocky character of the country.

At Toronto the average annual rainfall is 34 ins., the minimum 24 ins.. while at Parry Sound the average rainfall is 40 ins., and the minimum recorded in 27 years is 31 ins. The engineers state, therefore, that they can only safely assume that one-third of the rainfall on the land surface can be impounded in the lake. The evaporation from the lake surface will probably slightly exceed the rainfall on it. Assuming that in a dry season, 10 ins. of water can be impounded from the 1,340 acres, this will give an average daily yield of about 840,000 gals., or 583 gals. per min. The storage in the lake would be sufficient to guarantee a supply for about 8,000 people, with services unmetered, but by general metering of services, Trout lake might be depended upon to supply 12,000 people.

The engineers' estimates are for a rapid sand filter of the gravity type, with a capacity of 800,000 gals. per 24 hrs. The filter comprises four units each of 200,000 gals. capacity, one of which may be cut out for renewals or repairs, as the remaining three will be sufficient to deal with the maximum daily consumption. As the turbidity of Mill lake or Parry sound is never high, a much greater volume of water can be filtered, per square foot of filter area, than of more turbid river waters, or even Lake Ontario water at Toronto after gales.

Advantages Over Pressure Type

The filters will be superimposed over the clear water basin, and space provided in the filter house for storage of chemicals. Pressure filters are satisfactory, say the engineers, when not overtaxed or mismanaged, but the gravity type has these advantages:—

1. Their operation can be observed.
2. Removals and repairs can be more readily made.
3. The head can be varied with the condition of the sand or of the water.
4. More uniform and more satisfactory results can be attained.

If pressure filters be substituted for gravity filters, the cost of the Parry sound scheme or the Mill lake scheme might be reduced by $5,000 but the engineers do not advise this.

The report states that the expenses of operating the present water supply are approximately as follows: Salaries and wages, $2,500; electric power and fuel, $2,000; maintenance and repairs, $500; house services, $500; making a total of $5,500. The fixed charges amount to $5,000, giving a total expenditure of $10,500. The revenue from fire protection is $3,200; from schools and municipal use, $250; and from general consumers, $9,550; totalling $13,000. The engineers are of the opinion that the charges for maintenance and repairs are too low, and that no allowance has been made for depreciation.

The estimated cost of the new scheme is $107,000, and includes the following items: Land and right-of-way, $1,000; intake, 20 ins., 1,000 ft. long, $10,000; pump well and pump house, $6,000; power transmission lines, $4,000; two pumps, 750 gals., with motor, etc., $10,000; pumps and pipes to filters, $9,000; coagulating basin, 120,000 gals., $7,000; filters, capacity 800,000 gals. a day, $15,000; filter house, $5,000; 400,000 gals. reservoir, $15,000; venturi meter and chlorinator, $2,500; and new mains, $22,500.

As the existing intake from the pump house to Parry sound is of sufficient capacity for present requirements, the proposed new intake may be deferred for a few years, and, if this be omitted the estimate will be decreased by $10,000.

An annual expenditure of $19,970 will be made up as follows: Operating charges, $7,700; fixed charges, $12,270. The latter include $5,000 on existing works and $7,270 on new works and assume that debentures for these improvements will run for 30 years at 6% interest.

Estimates of Expense

To meet this expenditure it would be necessary to increase the annual revenue by about $7,470, besides taking care of the fixed and operating charges in connection with the sewage disposal works.

It is estimated that the Mill lake scheme will cost $128,000, as follows: Land and right-of-way, $2,000; 24-in. conduit from Mill lake to power house, $45,000; coagulating basin, filter equipment, reservoir, venturi and chlorinator, $44,500; pump house, $4,000; three pumps, each 750 gals., $13,000; and 12-in. force main, $19,500.

The cost of operation will be approximately $7,600; the fixed charges on old works, $5,000; and on new works, $9,300; making a total annual expenditure of $21,900. This scheme will necessitate an increase in the revenue of $9,400. By adopting a 20-in. pipe instead of a 24-in. one, the first cost will be reduced by $6,000 and the fixed charges lessened by $435 per annum.

The third scheme, that of obtaining water from Trout lake, is more expensive, and will probably cost $272,000, including the following items: Dams and head works at Trout lake, $12,000; 16-in. cast-iron main, $129,000; excavating and laying pipe, $48,000; additional cost for rock excavation, $30,000; reservoir, pumps and pump house, $32,000; and force main, $19,000. If wood-stave pipe be substituted for the cast-iron pipe estimated upon, the cost will be reduced by $30,000, or possibly $35,000.

The annual cost of operating the Trout lake scheme amounts to $4,200, and is less than either of the others, as pumping would only be necessary during fires. The fixed charges on old works are $5,000; on new works, $19,740; making a total of $28,940, which exceeds the revenue by $16,440. By using wood-stave pipe, the annual reduction in the fixed charges would be $2,180.

The conclusions arrived at by the consulting engineers are as follows:—

Conclusions

In the Parry sound scheme, the annual operating costs and fixed charges will be slightly higher than in the Mill lake scheme, but the difference is so trifling that it is not a factor in deciding between the two schemes. The Trout lake project would prove too expensive, and the yield from the watershed might not prove sufficient for the future requirements of the town. For the present, Parry sound water, filtered and chlorinated, would be a safe, wholesome water, cold, clear and palatable, and more acceptable to the citizens than Mill lake water. The Parry sound water, however, is now polluted with sewage, and this pollution will increase. Even if the sewage be treated, there will always be a danger of untreated sewage, or of sludge, being discharged into the river below the power house, and carried into the sound.

The water in Mill lake is contaminated by vegetable growths, which render it objectionable in its raw state. The flooded lands within the watershed of the Seguin river no doubt increase the natural contamination, but it is improbable that this will be further intensified, and it is not so dangerous as the Parry sound water, which is polluted by sewage.

Filtration will improve the quality of the Mill lake water, remove the organic vegetable matter, and render it safe to drink at all times. The analyses and examinations

which are being made by the health authorities should demonstrate whether it is possible to remove entirely the disagreeable tastes and odors.

After treatment, Mill lake water will be preferable to Parry sound water for practically all industrial uses, steam boilers, heating plants, laundry purposes, etc., but will not be so palatable as Parry sound water.

Taking the future development of the town into consideration, the engineers favor Mill lake as the source of future water supply.

STEEL CO. IMPROVES PUMPING FACILITIES

BY constructing an earthen dyke, 4,000 ft. long, around the eastern end of Grand lake, thus creating a new basin 5 ft. higher than was previously possible, the Dominion Iron & Steel Co., of Sydney, N.S., has increased the water area of the lake from 180 to 390 acres. This was necessary in order to secure an adequate supply of fresh water for the steadily growing steel company, who, during the last year, have installed a large coal washing plant and two modern batteries of Kopper's coke-ovens. The old spillway at the outlet has been replaced by a new 94-ft. spillway of substantial design.

The enlarged area which will hereafter be under water made necessary the relocating and rebuilding of two and a-half miles of the Sydney & Louisburg Railway Co.'s tracks between Victoria Junction and the steel company's assembly yard, the installation of new reinforced concrete culverts, new telegraph and telephone lines and a new water tank. The work also involved the raising—for a distance of 2,000 ft.—of the Sydney and Glace Bay Railway Co.'s tracks, as well as the power lines of that company.

An interesting feature in connection with this part of the work is that the alterations to the Sydney & Louisburg and the tram company's railway systems were effected without any delay or interference to the operations of their regular train or tram service. These changes in the track and pole lines required excavation of 80,000 cu. yds. of earth and rock.

The steam pumping equipment formerly in use, installed in 1910, has now been replaced by three new DeLaval electrically driven centrifugal pumps, each with a capacity of 4,000,000 gallons daily. Two of these units are expected to be in constant service. The third is a spare. These pumps are housed in a new fireproof building.

The connecting of the old water main to the new pump house required the raising and relocating of 3,200 ft. of the old 20-in. pipe line, but the change was made with only a slight interruption to the water supply of the Sydney coke plant.

The new elevation of Grand lake is about 100 ft. above the sea level. The increase of 5 ft. over the former level results in the total storage capacity being enlarged by 625,000,000 gals.

Steps have been taken to organize the municipalities in the Niagara district for the purpose of holding a "Niagara District Industrial Conference" next summer.

Since the federal government's purchase of the C.N.R., several provincial governments owning railway lines have endeavored to sell them to the Dominion cabinet. The New Brunswick government would like to dispose of the Valley Railway, while Alberta is ready to sell the Great Waterways, and British Columbia is anxious to part with the Pacific Great Eastern.

Estimated originally at about $5,000,000, the new Parliament buildings at Ottawa are expected to cost at least $8,000,000. This increase is mostly due to the rising cost of labor and materials, one and a half millions being charged up to the former and one million to the latter. Delays on the work are responsible for another half million. Definite instructions have been given that the buildings must be ready for temporary occupation at the February session of parliament.

Letter to the Editor

TRADE UNIONISM AND ENGINEERS

Sir,—After careful perusal of the article entitled, "No Room for Trade Unionism in Engineering Profession, Say Directors of American Association of Engineers," published in your issue of November 27th, 1919, the writer wishes to make these comments:—

The substance and reasoning tend towards an idealism of which the engineering profession already has too much, and appear to be the conclusions of the ultra clever and brilliant of the profession, who, either by hard labor or circumstances, have reached the pinnacle where remuneration or the struggle for existence ceases to bother them. They represent, so to speak, the capitalistic class of the profession.

To the vast multitude, the unnumbered hosts of the profession, the writer believes the conclusions expressed do not apply. In discussing methods, the term, "dignity of the profession," is used. Where, let me ask, is this "professional dignity," on construction works on which the professional engineers and inspectors (for engineers sometimes have to be inspectors) receive less remuneration than foremen and other labor-trade men?

These are conditions which should not exist unless engineers of this class are merely to render service to society.

Is the professional engineer not a laborer? He usually toils, not eight but fifteen or sixteen hours a day. He is no more nor less than an educated and specialized laborer. Why, then, should other laborers have unions and associations in which they are allowed to have at least some voice as to what the products of their efforts are worth, while the engineer stands alone, like a mendicant, and is compelled to take whatever his employer feels like giving him.

In the struggle for existence all laborers must necessarily co-operate and work together towards one end—viz., to make this world of ours a better place to live in. The artisans and laborers, less educated than professional engineers, have taken the lead by organizing and banding themselves together with advantage. Unionism, although it has faults, has advanced the status of these organizations and has placed some of their members in parliaments.

If our great professional body cannot evolve some policy for the betterment of its members as a whole, why not adopt labor unionism as it is, and then apply ourselves to elevate it, not only for our own benefaction, but for the welfare of all laborers, and strive to blend all classes together, until we reach the time when strife and strikes shall be no more?

FRED CHRISTIE.

Peterborough, Ont., December 11th, 1919.

The Midland district of the Department of Public Works of Canada has been added to the Central Ontario district, of which John M. Wilson is engineer in charge. This action was taken this week, after the death of Mr. Armstrong, who was district engineer at Midland.

N. Quesnal and James T. Lewis, both of the John Inglis Co., Toronto, will address the Ontario section of the American Society of Mechanical Engineers this evening (December 18th) at the Engineers' Club, Toronto. Their subject will be "Thirty Years' Progress in Boiler Construction in Canada."

The proposed joint water scheme for the border cities of Ontario (Windsor, Walkerville, Sandwich, Ojibway and Amherstburg) which will likely be voted on by the people of those municipalities at an early date, will cost about $2,100,000, according to the engineers' estimates. Of this amount $980,000 is required as compensation for the existing plants.

TWO NEW HYDRO-ELECTRIC POWER PLANTS FOR NOVA SCOTIA

THE Nova Scotia Power Commission has been authorized to proceed with the development of what are known locally as the Margaret's Bay water powers, about 20 miles from Halifax. The commission is undertaking immediately, and will carry forward as rapidly as possible, an initial development of about 8,000 h.p. It is probable that at a comparatively early date work will be undertaken at another site with an ultimate capacity of approximately 16,000 h.p.

NEW PREST-O-LITE PLANT AT TORONTO

THE Canadian National Carbon Co., Ltd., and the Prest-O-Lite Co., of Canada, Ltd., have jointly purchased ten acres at the corner of Bathurst street and Davenport road, Toronto, as a site for a new manufacturing plant. The new plant will consist of two buildings, one of which will be 80 by 400 ft., two stories high, with one section 80 by 80 ft., three stories high, to be occupied by the Canadian National Carbon Co., while the building for the Prest-O-Lite Co. will be 80 by 400 ft., two stories high. The heating plant will be housed in a separate structure, 50 by 60 ft., and will have room for installation of additional units.

All the buildings will be of reinforced concrete, with flat-slab floors and mushroom-type columns at 20-ft. centres, steel sash and brick curtain walls. The plant will be served by two switch tracks operated under a joint agreement between the Canadian Pacific and the Canadian National railways. It is expected that the plant will be ready for occupancy in May, 1920.

At present the two companies are operating five plants at different locations in Toronto. R. H. Combs, who has been general manager of the Prest-O-Lite Co. for the past three years, was also recently appointed general manager of the Canadian National Carbon Co. In addition to the plant described above, Mr. Combs states that the company will erect in the spring a new acetylene-gas plant in Toronto or vicinity, and a new storage-battery warehouse and assembly plant at Winnipeg. The contract for the Toronto plant has been awarded to Wells & Gray, of Toronto.

PROPOSED PETERBORO FILTER PLANT

PRELIMINARY plans and estimates of cost for a filter plant have been submitted by William Kennedy, Jr., consulting engineer, Montreal, to the Utilities Commission of Peterboro, Ont. The report states:—

"After a study of the quantity of water supplied to the town for the past few years, the quantity required at certain hours of the day, and especially during dry and hot spells of weather, together with possible heavy drafts of water for fire purposes during such dry and hot weather periods, also making allowance for an increase of population and water consumption, I have decided to recommend for first construction a mechanical gravity, sand filter plant of five million gallons' capacity per day, and in connection with this filter plant a covered reservoir of two million gallons' capacity.

"The filter plant will be designed for six million gallons' capacity per day in units of one million gallons to each filter unit, but five units only to be first installed, with the necessary connections made for the sixth unit when required.

"I may also mention that the plant is so designed as to permit of duplication of these six units, thus providing for an ultimate filter capacity of twelve million gallons daily.

"It is estimated that a five million gallons' plant will be sufficient for all purposes until the year 1925.

"The reservoir, containing filtered water, will have a present capacity of two million gallons, and is so designed and placed that its capacity may be increased to say four or five million gallons when so required.

"The additions to the filter plant or reservoir, or both, may be made without interfering with the water supply to the town.

"Full plans and specifications for the entire plant, including coagulating and clear water basins, low-lift pumps, etc., as above outlined, will be prepared, and from which tenders will be invited from contractors for the different classes of works, materials and equipment included. The whole of the necessary works and supply of materials, etc., will be divided into, say five contracts, but one contractor may undertake two or more contracts, or even the entire works required; or a part may be done by day work under the direction of your waterworks superintendent.

"The contracts may be divided about as follows:—

"1. Intake crib in river; intake pipe; suction well; construction work generally; and superstructure for filtration plant.

"2. Filter equipment.

"3. Low-lift pumping machinery; suction and discharge pipes within the building; electrical equipment.

"4. Outside pipe lines, including 24-in. discharge from the low-lift pumps; 30-in. conduit from clear water basin to pumping station, with valves, etc.; necessary sewers and drain connections.

"5. Two million gallon clear water reservoir.

"The specifications will also provide for receiving and the consideration of tenders for the entire filter plant from reputable contractors who may wish to make such modifications from the prepared plans and specifications as will suit their own designs and construction.

"It is intended to place the entire works on the Carnegie property recently acquired by your commission, except the pipe lines from the reservoir to the pumping station, which will run along the roadway.

"The estimated cost of the works above outlined is $300,000. More detailed plans may lower this estimate somewhat. My opinion is that the works, as per this report, can be built for the amount named.

"The main items in the cost of operation will be wages, fuel for heating purposes, power and chemicals.

"Assuming 3,600,000 gallons per day filtration, the estimated cost for operation—assuming chemicals at their present prices—is $10,700 per annum, or say, $8.15 per million gallons of filtered water, or assuming a population of 23,000, this is equal to say 47 cents per capita, interest and sinking fund not included."

The membership of the American Association of Engineers has passed the 10,000 mark, according to a bulletin sent out by the secretary of the association.

F. W. Thorold, consulting engineer, Toronto, is reporting on the water works system of Strathroy, Ont. The wells are not furnishing the amount of water expected, and it is anticipated that a new source of supply may have to be found.

A. D. Swan, Montreal, consulting engineer to the Vancouver Harbor Commission, has been instructed to proceed immediately with plans for the first unit of the proposed improvements, which will cost $5,000,000. Tenders for the initial work will be called for during the next six or eight weeks, it is said.

Members of the Manitoba branch of the Engineering Institute of Canada met December 9th in the Fort Garry Hotel, Winnipeg, and tendered a complimentary banquet to those of their number who have returned from overseas. The principal item on the program was the presentation by Brig.-Gen. H. N. Ruttan of an illuminated address to Capt. C. N. Mitchell, V.C., M.C. Following the silent toasting of the "glorious dead," T. R. Deacon proposed the toast to the guests, which was responded to by Maj. E. P. Featherstonhaugh, Lieut.-Col. R. H. Mulock, Maj. A. J. G. Taunton and Maj. C. W. Chivers. Short addresses were also given by Mayor C. F. Gray, Hon. G. Grierson and Isaac Campbell, a well-known lawyer.

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PAVEMENT GUARANTEES

HEATED discussion followed the proposal made last February to the American Road Builders' Association by its committee on economic status of guarantees for pavements on roads and streets, that 10% of the contract price of new paving, and 20% of the contract price of resurfacing work, be retained by municipalities as a guarantee of satisfactory construction.

It was claimed by the paving contractors that serious injury would be done to their business as a result of the retention of such a large percentage of their contract price. The committee took these objections into consideration and decided that they could be practically eliminated by reducing the amount of the retained percentage to a point where the money retained would merely equal the reserve which the contractor might reasonably be expected to set aside to cover repairs.

From the committee's final report, published in *The Canadian Engineer* for November 27th, 1919, it will be noted that the amount of the guarantee was reduced from 10% to 5% for new construction, and from 20% to 8% for resurfacing, with the idea that the contractor should be paid immediately upon completion of his work all the money which he has expended in construction, together with a 10% profit.

Francis P. Smith, consulting paving engineer, New York City, advises us that the committee were of the opinion that if paving work be constructed with reasonable care, the percentage guarantee finally recommended by the committee would be sufficient to cover all ordinary repairs, and that it is inadvisable and nearly impossible to set aside a reserve sufficiently large to cover anything like a complete failure of pavements, and that protection against such contingency should come from the guarantee bond.

ENGINEERING WORK AT THE FRONT

CANADIAN engineers who saw active service with units in France are probably without knowledge of the doings of other "sappers," who served in Siberia; and officers and men who were sent to Italy have no idea what kind of work had to be done in India; those who were in Serbia have heard little of conditions in Gallipoli; sappers who encountered great heat in Mesopotamia would be interested to know the conditions that were met on the Archangel front. Each and every front of our expeditionary force had its own trials and met conditions peculiar to the part of the world in which it was engaged. Sappers were called upon, probably everywhere, to fulfil their functions as complete units or field companies, but there is no doubt but that individual sappers, or small parties of sappers, were often sent to perform some important work, away from the force and lines of communication, where unique difficulties were encountered.

It is suggested that it would be very interesting to all engineers, whether they have served overseas or not, to read short accounts of the experiences of sappers who have served on the different fronts. *The Canadian Engineer* would like to receive and will gladly pay for articles dealing with the different phases of sapper activity on the various fronts.

Those Canadian engineers who served with bridging trains in Palestine and Egypt could write valuable accounts of engineering operations prior to the capture of Jerusalem, and those who were building railways could put together interesting material on this subject. Many Canadians also served with the Royal Engineers in India, Mesopotamia, Persia and other countries, and every man must have had some engineering experiences differing from those of his fellows.

COURT ACTION FOLLOWS ELECTROLYSIS

ACCORDING to T. H. Hooper, waterworks superintendent, approximately twenty-five miles of Winnipeg's water mains are at present affected by stray electrical currents from the tracks of the Winnipeg Electric Railway Co. Mr. Hooper has been instructed to report upon the cost of examining the whole of the twenty-five miles affected. The city is now suing the company for $18,000 alleged damages through electrolysis.

SUIT AGAINST ONTARIO "HYDRO"

THE council of Stamford township, Ontario, is about to bring a test suit against the Hydro-Electric Power Commission of Ontario in connection with the power canal which is being built between Chippawa and Queenston. In the past five months sixty wells have dried up in Stamford within half a mile of the canal. The Hydro Commission decline to admit liability and refuse to supply the farmers affected with water unless they pay for it.

MOTOR FLUSHERS EFFECT BIG SAVINGS

INTERESTING facts relative to the saving effected by the replacement of horse-drawn equipment by motor street-flushers are given in the report of the Works Commissioner of Ottawa. He says: "Each of our flushers mounted on motor trucks has replaced ten horse-drawn outfits. Two 1,000-gallon power flushers mounted on 3½-ton trucks operated all year, flushing an average of 18 miles of pavement, of all widths per day at a cost of $1.72 per mile. The total cost was $4,650 for 150 days of actual operation. The teams formerly used accomplished this work for $16,800."

THE editorial, business and mechanical staffs of "The Canadian Engineer" wish every reader a right merry Christmas and a happy New Year.

PERSONALS

JOHN M. WILSON, who has just presented to the Hamilton Harbor Commission his report on the proposed waterfront development at that city, was born September 7th, 1883 in Toronto, and was educated in the Toronto public schools, at Harbord Collegiate and at S.P.S., University of Toronto, where he graduated in 1908 in civil engineering.

After a year with the Wood Products Co., which concern has since been absorbed by the Standard Chemical Co., Mr. Wilson joined the engineering staff of the water works department, city of Toronto, in 1909, but a few months later he resigned in order to become city engineer of Moose Jaw, Sask. In 1911 he left the employ of the city of Moose Jaw and formed the contracting firm of Wilson, Townsend & Saunders, whose head office was at Moose Jaw at first but who moved to Toronto in 1913. In 1914 Mr. Wilson withdrew from that firm in order to accept an appointment as senior assistant district engineer of the Toronto office of the Public Works Department of Canada, and a month later he was appointed district engineer of the central Ontario district, with headquarters at Toronto, which position he still retains. The central Ontario district includes the large territory which may be roughly described as being bound on the south by Lake Ontario, on the west by Georgian Bay, on the north by a line drawn from Manitoulin Island to North Bay, and on the east by a line drawn from North Bay to Kingston.

ALFRED NOSWORTHY, architect and industrial engineer, formerly of Lacroix & Nosworthy, Quebec, has opened an office in Montreal.

LIEUT. H. E. BATES, who returned recently from service overseas, has accepted a position with the Laurentide Co., Ltd., Grand'Mere, P.Q.

THOMAS R. PATTERSON, of Auburn, Ont., has been appointed engineer for Huron county succeeding his father, Donald Patterson, who resigned owing to ill-health.

MAJOR P. J. JENNINGS has returned from service in German East Africa, and is now in Calgary with the Department of the Interior, Reclamation Service, Irrigation Branch.

H. A. GOLDMAN, of Toronto, has been appointed acting secretary of the Toronto branch of the Engineering Institute of Canada, in place of W. S. Harvey, who resigned on account of moving to the United States.

PAUL F. SISE has been elected president of the Northern Electric Co., Ltd., succeeding Edward F. Sise, who has resigned in order to devote his time to other activities. Paul F Sise returned last spring from overseas.

SPENCER BALL, who graduated in civil engineering at the University of Saskatchewan, with the class of 1916, has been appointed to a position on the hydraulic engineering staff of the Hydro-Electric Power Commission of Ontario. Mr. Ball enlisted immediately upon graduation and within a couple of months was sent to France, where he won a commission as lieutenant and served with the Canadian forces until he was wounded not long before the armistice. He was confined to a military hospital in England for nearly a year, and reached Canada only a few weeks ago.

J. E. HOLLAMAN, who made the surveys and plans for the proposed development of Hamilton harbor, was born May 1st, 1887, in Glasgow, Scotland, and was educated in the public schools of that city, at Allen Glen high school and at the Glasgow and West of Scotland technical college, where he studied architecture. Simultaneously with his college course, Mr. Hollaman served a five-year apprenticeship in an architect's office in Glasgow. After graduation he went to the United States and worked in New York City for two years, obtaining general office experience and also six months' supervision of structural steel work. In 1909 he came to Canada and entered the employ of the works department of the city of Toronto. He assisted E. L. Cousins in the preparation of reports on pay-as-you-enter cars and other phases of street railway operation and in the making of surveys and plans for proposed subways, and in other miscellaneous engineering work. In 1912 he left the employ of the city to follow Mr. Cousins to the Toronto Harbor Commission, where he was employed at first as chief draftsman, and later as assistant on special works. He resigned from the staff of the Toronto Harbor Commission in 1918 to join the aviation department of the Imperial Munitions Board, where he carried out surveys and miscellaneous engineering work under the direction of J. B. Carswell. In December, 1918, he entered the employ of the Hamilton Harbor Commission to assist John M. Wilson in making a report on the proposed waterfront development, and since that date he has been in charge at Hamilton of the harbor commission's engineering office.

OBITUARIES

ALEXANDER ORR, of Orr Bros., contractors, Toronto, recently died, aged 57. Mr. Orr was born in Barrie, Ont., and had resided in Toronto for 35 years, during which time he had been engaged in contracting.

SIR JOHN JACKSON died last Monday in England, at the ago of 68. He was famous as a contractor for public works in various parts of the world, and was a civil engineer of note. Among the great projects with which he was connected were the Manchester Ship canal, the railway across the Andes, the barrage across the Euphrates river near Babylon, the Mesopotamia irrigation works, and harbor works in Canada, South Africa, Singapore and other countries.

JOHN H. ARMSTRONG, one of the oldest employees in the service of the Public Works Department of the Dominion government, died December 13th, in Midland, Ont., from neuritis after a week's illness. Mr. Armstrong was district engineer of the Midland district, which district extends as far north as Byng Inlet and includes Parry Sound, Muskoka and portions of the Georgian Bay and Lake Huron. Mr. Armstrong was in the Toronto office of the department for many years ,but upon the formation of the Midland district, he was appointed as engineer in charge of it. Mr. Armstrong is survived by a widow, two daughters and three sons.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand or proposed, contracts awarded, changes in staffs, etc.

ADDITIONAL TENDERS PENDING

Not Including Those Reported in This Issue

Further information may be had from the issues of *The Canadian Engineer*, to which reference is made.

PLACE OF WORK	TENDERS CLOSE	ISSUE OF	PAGE
Bamfield and Ucluelet, B.C., wharf repairs	Dec. 22.	Nov. 27.	52
Banff, Alta., construction of bridge	Jan. 7.	Dec. 4.	45
Canwood, Sask., erection of school	Jan. 1.	Dec. 11.	48
Finch, Ont., road construction	Jan. 19.	Dec. 4.	45
Halifax, N.S., bridge construction	Jan. 5.	Dec. 11.	45
Montrose, Ont., steel superstructure of railroad bridge	Dec. 22.	Dec. 11.	45
North Battleford, Sask., power plant equipment	Dec. 20.	Dec. 4.	54
Vancouver, B.C., dredging and filling work	Dec. 29.	Dec. 11.	54
York Tp., Ont., cast-iron pipe, cast-iron specials, gate valves, hydrants and cast-iron valve covers and frames	Jan. 17.	Dec. 11.	54

BRIDGES, ROADS AND STREETS

Agassiz, B.C.—Movement is on foot for erection of bridge here.

Assiniboia, Man.—The erection of a temporary foot-bridge is contemplated. Clerk, Frank Ness, Kirkfield Park, Man.

Banff, Alta.—The bridge to be erected here over the Bow River, for which the Dominion government has called for tenders, will be built of reinforced concrete at an estimated cost of between $160,000 and $200,000. It is to be 416 feet long by 56 feet wide.

Beaverton, Ont.—Town council plans sidewalk and road repairs at cost of $5,000. By-law will be voted on. Clerk, G. A. Patterson.

Charleswood, Man.—Tenders addressed to A. B. Blakely, secretary-treasurer, Municipality of Charleswood, Man., will be received at the office of the Highway Commissioner, Winnipeg, Man., up to 12 o'clock noon on Tuesday, December 23rd, 1919, for the construction of concrete foundations, wooden Howe Truss spans and timber approaches thereto for a bridge over the Assiniboine River, near the village of Headingly, between the municipalities of Charleswood and Assiniboia. Plans and specifications may be obtained at the office of the Highway Commissioner, New Parliament Buildings, Winnipeg.

Charlottetown, P.E.I.—According to an announcement made by Hon. George E. Hughes, the government is planning to take advantage of the federal road grant and expect to expend $400,000 on roads next year.

Chatham, Ont.—By-law to raise $17,300 for the erection of a new steel bridge over McGregor's Creek at Princess St. will be submitted to ratepayers. City engineer, Mr. Adams.

Chatham, Ont.—Kent county council has recommended to the 1920 council the erection of a bridge across the River Thames at Prairie Siding. County road superintendent, L. A. Pardo, County Building, Chatham.

Chatham, Ont.—The farmers of Raleigh and Dover townships are urging the Kent county council to construct a bridge across the river a few miles below this city. County Road Supt., A. Pardo, County Bldg., Chatham.

Chatham, Ont.—City council passed a resolution, calling upon the Ontario government to proceed with the provincial highway scheme, and to designate the Longwoods Rd. as the route of the highway between Chatham and London.

Chilliwack, B.C.—Tenders will be called at once for construction of asphalt pavement at cost of $18,000. City clerk, Peter J. Brown.

Coquitlam, B.C.—Municipal council has put forward a proposition to the government that they rock the Clarke Rd. for a mile at an estimated cost of $6,200. Clerk, A. Haliburton.

Danville, Que.—Municipal corporations of St. Camille, Wottonville, Wotton and Shipton, Que., have decided to build a road between Marbleton and Danville under government specifications. Address, L. P. Bishop, Danville.

Headingly, Man.—If the project is approved by the municipalities interested, a $36,000 bridge will be built over the Assiniboine River at Headingly next summer. The structure will be of concrete and wood. By-laws will be submitted in Charleswood and Assiniboia to authorize the expenditure.

Kenora, Ont.—A by-law to borrow $25,000 for road improvements will be submitted to electors at municipal elections. Clerk, J. E. Currie.

Kent County, Ont.—County council recommended that the plans and specifications of the County Engineer for pavement at Wallaceburg, Ont., be accepted and be forwarded to the Department of Highways for approval. Plans and specifications of the Duffis Creek bridge will also be submitted to the department.

Levis, Que.—City council gave second reading to by-law to borrow $28,280 for paving of roads. Mayor, Mr. Belleau.

Mindemoya, Ont.—A definite good roads program on Manitoulin Island will be promoted as a result of a recent meeting held here, which was addressed by Hon. Beniah Bowman and an engineer from the Provincial Good Roads Department.

Morris, Man.—Engineers are here making plans and specifications for a bridge across the Red River. Approximate cost, $100,000. Provincial Highway Commissioner, A. McGillivray, Parliament Buildings, Winnipeg.

Ottawa, Ont.—The good roads policy initiated by the government this year in the form of an appropriation of $20,000,000, extending over a term of five years, is taking definite form and the spring and summer will see construction work actively in progress. The provinces will initiate and carry on the works, the Federal government approving the plans and contributing 40 per cent. of the cost. Ontario so far has filed plans for a provincial highway from Windsor to the Quebec boundary by way of Hamilton, Toronto, Kingston, Brockville and Prescott, with a branch road from Prescott to Ottawa. The plan of the Quebec government is to construct a first-class roadway from Hull to Montreal.

Port Hardy, B.C.—It is reported that the provincial government will construct a highway between Port Hardy and Coal Harbor next year. Minister of Public Works, Hon. J. H. King, Victoria.

Quebec, Que.—The Quebec Board of Trade and that of Drummondville are communicating with the officials of a number of cities and towns along the south shore of the St.

Lawrence River to advocate a highway that would lead from Montreal to Quebec on the south shore. The promoters of the idea have organized a monster delegation from every city, town, village and parish along the proposed highway, and this will meet the Provincial Cabinet, requesting the construction of the new road without delay. The idea is to start work early next spring.

Sarnia, Ont.—Lambton county council will purchase stone-crushers and other road machinery.

Sarnia, Ont.—A by-law to raise $35,000 for the purchase of an asphalt plant and equipment will be submitted to the ratepayers at the municipal elections. City clerk, J. D. Stewart.

Simcoe, Ont.—Norfolk county council contemplates purchasing more road machinery. County road superintendent, G. R. Marston, Simcoe.

St. Clements, Man.—Tenders will be received by Thos. Bunn, secretary-treasurer, up to noon on Tuesday, December 23rd, 1919, for the supply and delivery of approximately 6,200 cubic yards of gravel. For specifications, apply to W. G. Mawhinney, Municipal Engineer, Municipal Hall, East Selkirk, Man., or to A. McGillivray, Highway Commissioner, Winnipeg.

St. John, N.B.—City council will have plans and specifications prepared for paving the North and South sides of Haymarket Square with granite blocks on a cement concrete foundation. City engineer, G. N. Hatfield.

St. Polycarpe, Que.—Municipality plans construction of 11,043 ft. of gravel roads; also macadam road, estimated to cost $25,000. Secretary-treasurer, J. R. Ouimet.

Three Rivers, Que.—Council plans construction of pavement at cost of $100,000. Engineer, Z. St. Lambert.

Toronto, Ont.—Board of Works decided to have Davenport Rd. paved and otherwise improved at a cost of about $289,550.

Toronto, Ont.—Works Committee requested Commissioner of Works Harris to bring in a report recommending the grading of Woodbine Ave., between Kingston Rd. and Gerrard St.

Toronto, Ont.—The Board of Works, subject to a report by Commissioners Harris and Forman, decided to extend Norway Ave. through to Lee Ave. The cost, exclusive of grading, will be about $40,000.

Vancouver, B.C.—The Woodward Departmental Stores plan erection of an overhead bridge over the alley between Hastings and Cordova Sts.

Victoria, B.C.—The Provincial Department of Public Works has under consideration the construction of a road from Campbell River to Salmon River, in Sayward district. Minister of Public Works, Hon. J. H. King.

Winnipeg, Man.—Permission has been granted by the city council for the erection of a footbridge from Donald St. to Portage Ave. City clerk, C. J. Brown.

Winnipeg, Man.—City Engineer W. P. Brereton will report on the cost of lengthening the approach to the Arlington St. bridge and on draining the McPhillips St. subway.

Winnipeg, Man.—Manitoba province, in conjunction with the municipalities, is planning the construction next year of several large bridges at an approximate cost of several hundred thousand dollars.

Winnipeg, Man.—A. McGillivray, Provincial Highway Commissioner, has announced that plans have been completed by municipalities of the province of Manitoba for the issue of debentures for an expenditure of over $5,700,000 on road-building.

Winnipeg, Man.—Tenders addressed to R. C. Desrochers, secretary, Department of Public Works, Ottawa, will be received until 12 o'clock noon, Friday, December 19th, 1919, for the construction of roads and sidewalks at Tuxedo Military Hospital, Winnipeg. Plans and specifications may be seen at the offices of the Chief Architect, Department of Public Works, Ottawa; the Superintendent of Military Hospitals, Notre Dame Investment Building, Winnipeg, and the Resident Architect, Lindsay Building, Winnipeg, Man.

Wroxeter, Ont.—Town council plans construction of cement walks at cost of $5,000. By-law will be voted on. Clerk, D. M. MacTavish.

York Tp., Ont.—The township solicitor was instructed by the council to proceed with the expropriation of land for the extension of Woodville Ave.

WATER, SEWAGE AND REFUSE

Dresden, Ont.—A by-law will be voted on at the municipal elections to provide $10,000 for a water tank and equipment for a waterworks system. Clerk, J. T. Bridgewater.

Guelph, Ont.—Plans for the construction of a sewage disposal plant to serve Guelph township have been approved by the Provincial Board of Health. City engineer, F. McArthur.

Hamilton, Ont.—Board of Control recommended construction of 2-inch water main to the Isolation Hospital at a cost of $3,500. City engineer, E. R. Gray.

Hamilton, Ont.—City council intends to construct a 4-inch force sewer, well and pumping plant on Simcoe St., at an estimated cost of $3,865.34. City clerk, S. H. Kent,

Hamilton, Ont.—Board of Control accepted the tenders of City Engineer E. R. Gray for installation of sewers on Bay and Stinson Sts. and Roxbury Ave. amounting to about $2,000.

Kincardine, Ont.—By-law will be submitted to ratepayers at next municipal election to borrow $9,000 for extensions to waterworks system. Clerk, John H. Scougall.

Nanaimo, B.C.—Two schemes for the extension of the waterworks system are under consideration by the city council. The first one is estimated to cost $166,051, and the second, $199,107. Mayor, H. McKenzie.

Newmarket, Ont.—Town council intends to construct sewers on several streets at an estimated cost of $18,000. Clerk, P. J. Anderson.

Orillia, Ont.—Town council has issued debentures to the amount of $24,000 for waterworks. Clerk, C. E. Grant.

Petrolia, Ont.—Town council plans construction of glazed tile sewer. Clerk, John McHattie.

Port Dalhousie, Ont.—Town council plans waterworks system. Clerk, J. M. A. Waugh.

Sandwich and Ojibway, Ont.—No award was made by Essex Border Utilities Commission for completion of south sewage interceptor, for which tenders closed November 27th. Commissioner may consider cost-plus basis.

St. Louis de Gonzague, Que.—Dominion Department of Public Works let contract to O. Poliquin, Portneuf, Que., for two concrete abutments.

St. Thomas, Ont.—Tenders will be received by W. C. Miller, city engineer, until noon, Tuesday, December 30th, 1919, for the installation of electric and gasoline auxiliary pumping equipment for the waterworks. Plans and specifications may be obtained at the city engineer's office.

Three Rivers, Que.—Council plans aqueduct improvements at cost of $20,000. Clerk, A. Nobert.

Three Rivers, Que.—Council plans construction of sewers at cost of $75,000. Engineer, Z. St. Lambert.

Toronto, Ont.—Tenders addressed to T. L. Church (mayor), chairman, Board of Control, City Hall, will be received up to 12 o'clock noon on Tuesday, February 10th, 1920, for the supply and installation of: Tender No. 36—One or more 16 to 20 million Imperial gallon centrifugal pumps at the waterworks main pumping station. Specifications may be obtained at the Works Department, Room 12, City Hall.

Toronto, Ont.—The Oakoal Co. has offered to buy the city garbage for $15,000 per year At the present time it costs the city $172,000 to dispose of it. The company proposes to erect a plant for the manufacture of briquettes

Driveways of old macadam in Mount Pleasant Cemetery, Toronto, Ont., resurfaced with "Tarvia-X".

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from the garbage. The Works Commissioner will report on the matter.

Windsor, Ont.—If the plan of the Essex Border Utility Commission to consolidate the waterworks systems of the border municipalities by taking over the Windsor and Walkerville plants is placed before the taxpayers of Windsor at the municipal elections in January, the Windsor Water Board will ask the city council to submit a by-law authorizing the expenditure of $350,000 to construct a filtration system as an addition to the present plant.

LIGHT, HEAT AND POWER

Alliston, Ont.—Council has issued debentures to the amount of $8,000 for Hydro-Electric extensions. Clerk, J. E. Addis.

Almonte, Ont.—A by-law regarding the acquisition of the Wylie power plant will be submitted to the electors. The sum mentioned is $25,000, of which $20,000 is for the actual cost of purchase and the balance for development.

Crediton, Ont.—Estimates will be prepared and by-law submitted shortly for Hydro system, street lighting, etc. Engineer, Mr. Doerr, superintendent of Hydro at Exeter, Ont.

Fort Metachewan, Ont.—British Syndicate plans construction of power development plant to cost $250,000. Engineers, Sutcliffe and Neelands, New Liskeard, Ont.

Halifax, N.S.—Tenders, addressed to E. H. Armstrong, Commissioner of Public Works and Mines, Halifax, N.S., will be received until 1 o'clock p.m., on Wednesday, December 24th, 1919, for supply of material and erection of a transformer house on the grounds of the Nova Scotia Technical College at Halifax, according to plans and specifications which may be seen at the office of the Department of Public Works and Mines, Halifax, N.S. E. H. Armstrong, Commissioner of Public Works and Mines.

Halifax, N.S.—The Nova Scotia Power Commission has been authorized to proceed with the development of the water powers at St. Margaret's Bay, and will undertake and carry out as rapidly as possible an initial development capable of supplying in Halifax 7,800 h.p. The initial expenditure is roughly estimated at $1,000,000, and the expansion of the plant to its greatest capacity, which will be carried out as the demand for power increases, will cost approximately $200,000 more. Chief Engineer of Commission, H. K. Smith.

Iroquois Falls, Ont.—The Abitibi Power & Paper Co., which now develops 20,000 h.p. here and owns a model townsite with population of 2,500, is planning large extensions. The company is now turning out 300 tons of paper a day, and it is said that they will more than double their output and spend about $3,000,000 on additional mills, power development, etc. It is rumored that a contract has already been let to Morrow & Beatty, Ltd., of Peterboro, Ont., who were the contractors for the initial hydro-electric installation, for extensions to the power development costing between $1,000,000 and $1,500,000.

London, Ont.—General Manager Buchanan, of the Public Utilities Commission, stated recently that the commission stands ready to build a supplementary electric power plant the moment the city begins a new dam across the river. It is believed the dam could be erected for about $150,000, and it would cost another $100,000 to install the power generating plant.

Newberry, Ont.—Village council plans Hydro system. By-law will be submitted in January. Reeve, Mr. Holman.

Toronto, Ont.—Board of Control sent on a recommendation to the city council approving the application to the Railway Board for power to issue debentures to the amount of $950,000 for extensions to the Hydro-Electric system in this city.

Vancouver, B.C.—British Columbia Electric Ry. Co. plans extensions to gas plant at cost of $150,000.

Windsor, Ont.—A by-law to take over and place under the direction of the Hydro Commission the lighting plant of the S.W. and A. Ry. at a cost of $190,000 will be submitted to ratepayers at civic elections.

RAILWAYS

Guelph, Ont.—City council decided to submit to the ratepayers the by-law respecting the sale of the Guelph Radial Ry. to the Hydro-Electric Power Commission of Ontario for $150,000.

Oshawa, Ont.—Oshawa Railway Co. proposes to lay additional trackage.

Quebec, Que.—The building of a new railroad into the Temiskaming region and the expenditure of five million dollars to help develop new rural communities was announced last week by Sir Charles Fitzpatrick, Lieutenant-Governor of Quebec.

Quebec, Que.—The farmers of Lake Saint John district have formed a company, to be known as the "Farmers' Railroad Company of Normandin Township," and plan the construction and operation of a railroad several hundred miles in length. The company will apply for a provincial charter at the coming session of the legislature.

Quebec, Que.—Roberval and Saguenay Railroad will apply to legislature for power to construct steam or electric line. Solicitors, Lapointe and Rochette, 42 St. Pierre St., Quebec.

Toronto, Ont.—Tenders have been called for the construction of the Mount Pleasant car line.

Welland, Ont.—According to a letter received by W. M. German, Industrial Commissioner for this city, from E. D. Cahill, general solicitor of the T., H. and Buffalo Ry. at Hamilton, neither the C.P.R. nor the T., H. and B. contemplate the construction of another railway line to the Niagara River through this county, as has been recently reported. It is thought, however, that such a new line to the frontier is contemplated, but that it will run from St. Catharines to the border north of this county in competition with the Grand Trunk line. Reports state that a new international bridge to New York State is to be built over the Niagara River by the C.P.R. or the T., H. and B., or probably by both lines in conjunction.

Winnipeg, Man.—Premier Norris, of Manitoba, recently stated that if the Federal government refuse to build a railway line into the Copper Lake gold district, the provincial government will act in the matter.

York Tp., Ont.—Township council decided to call for a vote on the Toronto and Eastern Radial bond guarantee about the middle of January.

FACTORIES AND LARGE BUILDINGS

Acton, Ont.—Toronto Suburban Railway Co. plans erection of freight sheds. General manager, W. Radford, 2896 Dundas St. West, Toronto.

Barton Tp., Ont.—Township council has given first and second readings to a by-law for the erection of a memorial community hall. Estimated cost, $35,000.

Barton Tp., Ont.—Township council authorized the rebuilding of the Homeside fire hall, destroyed by recent storm. Clerk, A. G. E. Bryant, Mount Hamilton, Ont.

Belleville, Ont.—Board of directors of Albert College plan erection of new buildings on 50-acre site given by city. Principal, Dr. Baker.

Brantford, Ont.—Steel contract in connection with erection of $75,000 factory for Barber-Ellis, Ltd., Toronto, let to Burlington Steel Co., Hamilton, and roofing contract to Carmichael Waterproofing Co., Toronto.

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Brantford, Ont.—The Brantford Cordage Co. will replace their brick warehouse, recently destroyed by storm, with a steel and brick structure, and P. H. Secord and Sons Construction Co. has commenced the work.

Brownsburg, Que.—Douglas Bremner Co., 10 Cathcart St., Montreal, have general contract and masonry and will let sub-contracts and buy material for three factory buildings costing $50,000 for Dominion Cartridge Co.; head office, 120 St James St., Montreal.

Campbellton, N.B.—Contract let to J. and A. Harquail for erection of $50,000 school.

Cobourg, Ont.—A Rochester firm of furniture manufacturers contemplate locating a plant here and are asking for a $50,000 loan from the town. Address, A. L. Jex, Cobourg.

East St. John, N.B.—Town council plans erection of school. Secretary, Gordon Flewelling.

Fredericton Junction, N.B.—The C.P.R. is planning to erect a $50,000 station here.

Fredericton, N.B.—Contract for improvements to the Y.M.C.A. building let to Joseph Timms.

Galt, Ont.—South Waterloo Trades and Labor Council has under consideration the erection of a Labor Temple in this city at a cost of $50,000 or $60,000.

Glace Bay, N.S.—Y.M.C.A. have secured a site for erection of building.

Guelph, Ont.—A movement is on foot for extension of Winter Fair building. Address, Ald. Burgess.

Haileybury, Ont.—Business block destroyed by fire with loss of $40,000. Owner, F. Askar.

Halifax, N.S.—The Maritime Telegraph and Telephone Co. will introduce into this city the improved automatic telephone system, and in preparation for this have awarded contract to Rhodes, Curry and Co. for the erection of a new building to cost approximately $400,000.

Hamilton, Ont.—Contract let to Canadian Engineering and Construction Co., Bank of Hamilton Building, for foundation work for factory of Firestone Tire and Rubber Co.

Hamilton, Ont.—Firth Bros., of this city, will erect a factory at the corner of Cannon and Hughson Sts.

Hamilton, Ont.—A large new theatre will be erected on King William St., between Mary and Katharine Sts.

Hamilton, Ont.—Tallman Brass Co., Burlington St., will extend its plant.

Hamilton, Ont.—Extensive alterations to Grand Theatre are planned by A. J. Small, 11 Adelaide St. West, Toronto.

Hamilton, Ont.—General contract, masonry and carpentry let to Frid Construction Co., Clyde Building, for factory costing $75,000 for Norton Co., Worcester, Mass. Hamilton Bridge Co. have structural steel contract.

Hespeler, Ont.—Town council plans erection of school addition. Clerk, M. E. Jardine.

Heward, Sask.—The Great War Veterans' Association are considering the erection of a memorial hospital.

Humboldt, Sask.—The Benedictine Fathers plan construction of a college.

Ingersoll, Ont.—Tenders for erection of Separate School will be called by Father Gnam. Estimated cost, $20,000.

Kingston, Ont.—Tenders will be called for erection of two bathing-houses. Clerk, W. W. Sands, M.D.

Kitchener, Ont.—Tenders will be received up to December 31st by T. A. Witzel, 399 King St. East, for all trades for erection of $15,000 factory addition.

London, Ont.—Members of Cronyn Memorial Church are considering the erection of a new parish hall.

Loreburn, Sask.—Contract let to J. W. Osborne by municipal council for erection of hall at cost of $12,000.

Montreal, Que.—Contract let to J. Marcotte for erection of warehouse for British American Oil Co. Estimated cost, $8,000.

Montreal, Que.—A permit has been taken out in the name of M. A. Mercure, 419 Labrecque St., for the reconstruction of Laval University. The amount mentioned is $40,000.

New Waterford, N.S.—Town plans erection of hospital to cost $80,000. Clerk, J. McKinnon.

New Westminster, B.C.—Hyslop Hardware Co. will erect a storage building on Gilley St.

New Westminster, B.C.—Electors will vote on by-law in January providing for erection of $60,000 cold storage plant. Mayor, R. W. Gray.

Niagara Falls, Ont.—Fire completely gutted the local car barn of the Niagara, St. Catharines and Toronto Street Ry. recently. Loss, $40,000.

Orono, Ont.—C. J. Thornton proposes to erect a sawmill. Electric power will be utilized.

Ottawa, Ont.—Tenders will shortly be called by P. Levesque, architect, 115 St. John St., Quebec, Que., for erection of bank for La Banque Nationale. Estimated cost, $80,000.

Owen Sound, Ont.—A by-law to supply funds for the erection and equipment of a technical school and necessary additions to the Collegiate Institute at an approximate cost of $180,000 will be submitted to the electors in January.

Peace River, Alta.—The Garke Elevator Co. plans erection of an elevator.

Perdue, Sask.—F. O. Taylor has general contract for school costing $19,000 for Perdue School District.

Peterboro', Ont.—By-law granting a free site and fixed assessment to the Canadian Aladdin Co., Ltd., a branch of the present company in Bay City, Mich., will be submitted to the ratepayers. The company proposes to erect a plant.

Point Grey, B.C.—Royal Financial Corporation proposes to erect six storehouses.

Point Grey, B.C.—Coast Box Co. proposes to erect a $12,000 factory.

Quebec, Que.—The Quebec Glove and Leather Co. is making an addition to its premises on 3rd Ave. This addition will be a three-story structure, and will cost approximately $1,200.

Quebec, Que.—Repairs to the extent of $35,000 are to be made to the Boswell Brewery plant on St. Valier St.

Regina, Sask.—Plans for additions to Collegiate Institute are under consideration by Collegiate Board. Address, W. G. Styles.

Regina, Sask.—Premier Martin has announced that the Department of Education will build nine more public schools in the spring in the Mennonite districts of the province.

Regina, Sask.—Regina Oakoal Co. plans to establish a plant, at a cost of between $35,000 and $40,000, for the conversion of garbage into fuel.

Sandwich, Ont.—Assumption College plans erection of college building. President, Rev. F. Foster.

Sandwich East, Ont.—Fire totally destroyed Lakeview Hotel. Owner, Frederick J. Kirsch. Loss, $20,000.

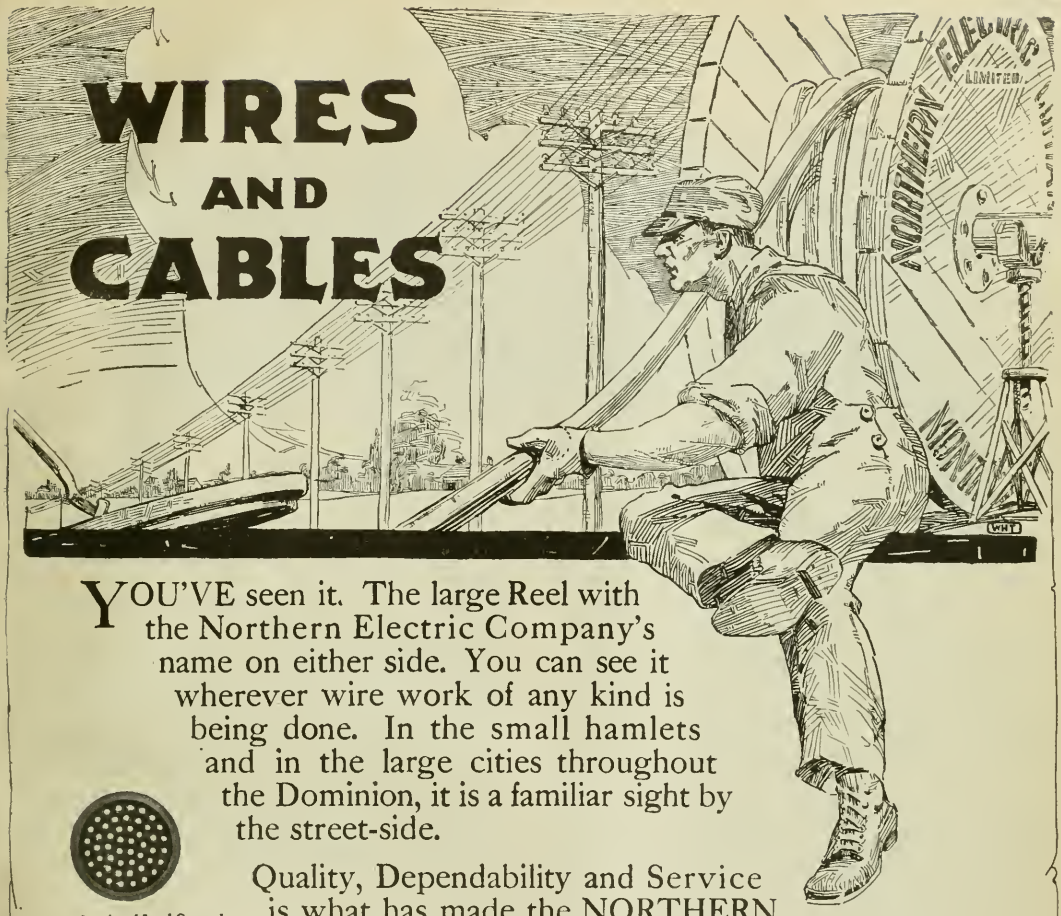
Sarnia, Ont.—According to an announcement made by S. A. Howard, a Detroit banker, plans are well under way by the Lake Huron River Steel Corporation to build a $15,000,000 steel plant along the River St. Clair, work to start on March 1st. Among those associated with Mr. Howard are J. J. Mahon, of the Imperial Munition Board of Canada, and a number of other prominent Canadian and American steel magnates.

Sarnia, Ont.—By-law will be submitted to ratepayers at municipal elections to grant $75,000 to the Sarnia General Hospital for erection of new buildings. City clerk, J. D. Stewart.

Sarnia, Ont.—The Sarnia Chamber of Commerce has secured an option on the Northern Hotel, which, it is stated, it will turn into a Chamber of Commerce building and modern apartment house.

Three Rivers, Que.—City plans erection of civic hospital to cost $50,000. Clerk, Art. Nobert.

WIRES AND CABLES



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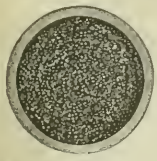

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Three Rivers, Que.—Arsenault and Ahern, 44 St. Pierre St., have general contract, and Germain and Freres, 87 St. Antoine St., have plumbing for Roman Catholic school, costing $200,000.

Toronto, Ont.—York county council plans erection of registry office.

Toronto, Ont.—University of Toronto plans erection of women's building. Superintendent, Graham Bell, University of Toronto.

Toronto, Ont.—Total cost of erection of club building planned by Beaches G.W.V.A. is $200,000. Member of committee, Alfred Scadding.

Toronto, Ont.—Fire Chief Russell has selected a site for a new fire station in Ashbridge's Bay district at Commissioner and Munition Sts.

Toronto, Ont.—Permit granted to Robert Gray for one-story metal-clad machine shop, north side of Geary Ave., near Dufferin, at cost of $1,000.

Toronto, Ont.—Work has started on the construction of a large addition to G. E. Gooderham and Co.'s motor car showrooms and garage on Sheppard St.

Toronto, Ont.—Permit issued to the Wm. Davies Co. for erection of a store at 29-31 Queen St. West. The new building is now being erected. It will cost $60,000.

Toronto, Ont.—A three-story brick and concrete building is being erected at 105-7-9 West Richmond St. for the Rapid Electrotype Co., and will be ready about January 1st.

Toronto, Ont.—A moving-picture theatre to cost in the neighborhood of $50,000 is to be constructed on Danforth Ave., near Bathgate. Excavations are at present under way.

Toronto, Ont.—Brouse, Mitchell and Co., 71 Bay St., have purchased the four-story brick building at 75 Bay St., and alterations costing about $15,000 will be made early in the new year.

Toronto, Ont.—Canadian Allis-Chalmers, Ltd., 212 King St. West, Toronto, have steel contract for plate mill costing $200,000 for Baldwins, Ltd., Swansea, Wales. Superintendent, Mr. Cowan, Ashbridge's Bay, Toronto.

Toronto, Ont.—Permit issued to G. Hesk for one-story brick public storage garage, 2189 Queen St. East, at cost of $8,500, and to Misses L. and E. Colvin for three-story addition to Assembly Hall, 1691-1693 Dundas St. West, near Mavety St., at cost of $6,800.

Toronto, Ont.—Plans are being prepared for a $200,000 home for the nurses of St. Michael's Hospital. The building will be of reinforced concrete, six stories and a basement, and construction will be started in the spring. Architects, Hynes, Feldman and Watson, McKinnon Building.

Toronto, Ont.—The Aero Club of Canada have received a proposition from a municipality in Canada, the name of which they will not divulge, for the setting aside of approximately one thousand acres for an aerodrome site. As soon as the scheme is completed the Aero Club state that public announcements will be made.

Toronto, Ont.—Three new factories will be erected near the corner of Dupont St. and Manning Ave. The north-east corner has been sold to the Willard Chocolate Co., who will build an ice cream factory at a cost of $140,000. On the north-west corner the Ward Baking Co., of New York, will erect a large bakery, and on the 150-foot site on the north side of Dupont St. the Kinnear Wholesale Grocery Co. will build a $150,000 warehouse. The construction of the factories is expected to begin in a few months.

Vancouver, B.C.—Edward B. Welch has taken out a permit for the erection of a service garage at 660 Howe St. at a cost of $24,000.

Vancouver, B.C.—The Schaake Machinery Co. has taken out a permit to build a 40-ft. addition to their factory on Industrial Island, which is to be used as a machine shop. It will cost $5,000.

Vancouver, B.C.—The Canada Western Woollen Mills have taken out a permit for a $4,000 warehouse at 440 Clark Drive. The Gordon Drysdale Co. have also taken out a permit for $4,000 to build an addition to the rear of their premises on Granville St.

Vancouver, B.C.—David Spencer, Ltd., plan large addition to their premises. Approximate cost, $1,000,000.

Verdun, Que.—General contract, masonry, excavations and foundations in connection with $100,000 school addition let to Archambault and Leclair, Montreal, by Protestant School Commission; plumbing and heating contract let to Thos. O'Connell, 183 Ottawa St., Montreal, at $16,800.

Victoria, B.C.—The lumber mill of Moore and Whittington was gutted by fire recently. Estimated loss, $90,000.

Victoria, B.C.—City council is considering salt water swimming bath scheme at a total cost of $45,000, including $30,000 for erection of building. Architect, J. C. M. Keith.

Walkerton, Ont.—Children's Aid Society plans erection of new building in Bruce county next spring. Treasurer, Mr. Burrows.

Welland, Ont.—S. L. Lambert plans erection of theatre.

Westboro, Ont.—A new church, to take the place of All Saints' Church, will be erected here next year. Rector, Rev. (Col.) R. H. Steacy.

Windsor, Ont.—Property at the corner of Ouellette Ave. and Park St. has been purchased by the directors of the Border Cities Hotel Co. for the erection of the proposed million dollar hotel, upon which work of construction will be started about February 15th.

Windsor, Ont.—Tenders on all trades in connection with erection of theatre will be received by J. and J. J. Allen, Richmond and Victoria Sts., Toronto, up to January 1st. Plans with owners and with Howard Smith, 6 Victoria Block, Windsor.

Winnipeg, Man.—The board of governors of the University of Manitoba decided to lay the matter of the erection of a permanent university for the province before the government, along with the plans and estimated cost.

Winnipeg, Man.—The erection of a manufacturing plant here to take care of small industries is under consideration by the Industrial Development Bureau of the Board of Trade.

Winnipeg, Man.—Carter, Halls, Aldinger Co. have general contract for branch bank for Merchants' Bank of Canada. Architects, J. D. Atchison and Co., 914 Boyd Building.

Wynyard, Sask.—Town council plans erection of municipal hospital at cost of $30,000. Clerk, T. B. Baker.

MISCELLANEOUS

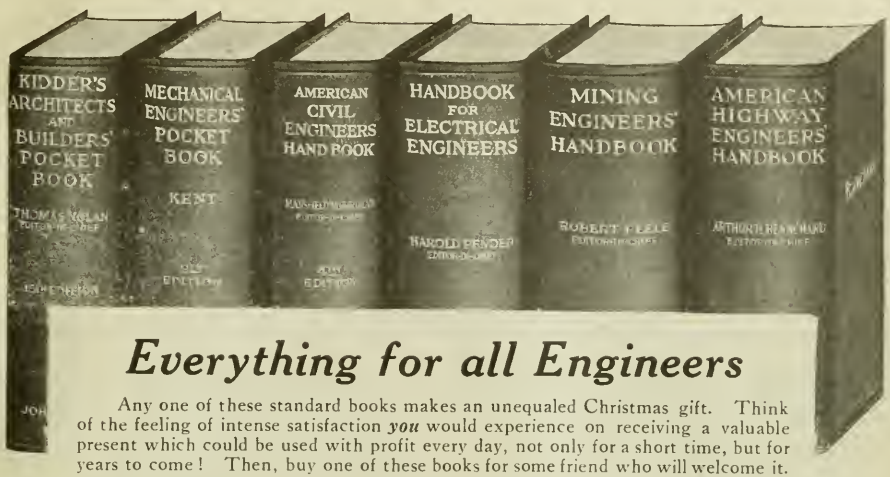
Brantford, Ont.—By-laws to be submitted to the electors in January include the following: New Lorne bridge, $211,000; purchase of new motor fire truck, $10,800.

Chatham, Ont.—By-law to raise $10,000 for the establishment of an athletic park will be submitted to ratepayers.

New Westminster, B.C.—Tenders, addressed to R. C. Desrochers, secretary, Department of Public Works, Ottawa, will be received until 12 o'clock noon, Wednesday, January 7th, 1920, for the construction of a dam, embankment and three groynes at Nicoamen Island, Fraser River, District of New Westminster, B.C. Plans may be seen and specification obtained at the Department of Public Works, Ottawa; at the offices of the District Engineers at Victoria, B.C.; New Westminster, B.C., and at the Post Offices, Vancouver, B.C., and Deroche, B.C.

Ottawa, Ont.—The following are among the companies recently incorporated: The Dominion Engineering and Machinery Co., Ltd., with a capital stock of $3,000,000, and head offices at Montreal; Super-Cement (America) Co., Ltd., Toronto, $500,000; Scientific Experimenter, Ltd., Montreal, $100,000.

Ottawa, Ont.—City council awarded contract for 5,000 pounds of lead pipe to McKinley and Northwood, and for five tons of pig lead to the Canada Metal Co.



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C.E.—18-12-19

Peterboro', Ont.—By-law to purchase Riverside Park and adjoining properties as a public park and athletic grounds will be submitted to the ratepayers at the January elections.

South Slocan, B.C.—Dennis Sullivan, of Vallican, B.C., has received the contract for the furnishing of 1,050 poles for the Dominion government telephone line from South Slocan to Slocan City.

St. Catharines, Ont.—The city council will ask the Dominion government to turn over to the Victoria Park Commission the lands of the Welland Canal, now out of use for navigation purposes, to be transformed into a provincial park reservation.

St. Lambert, Que.—The town has taken over from private companies the operation of its water, light and power services.

St. Thomas, Ont.—City plans re erection of grand stand, recently destroyed by storm. Steel or concrete construction. Clerk, W. B. Doherty.

Toronto, Ont.—The Harbor Commission have agreed to develop the waterfront from Woodbine Ave. to the city limits if the city will purchase the lots. The development will be on the lines of the Humber improvements.

Toronto, Ont.—Tenders will be received up to and including January 15th, 1920, for the manufacture, crating and delivery of two thousand five hundred survey posts made of 1-in. wrought iron pipe, each 30 ins. long, bronze cap, welded foot plate and cement filled. Plans and specifications may be seen at the office of L. V. Rorke, director of surveys.

Vancouver, B.C.—According to A. D. Swan, consulting engineer of Montreal, Que., who has been appointed in connection with the work, the Dominion government has authorized the construction, at a cost of $5,000,000, of the first unit of the Vancouver harbor works. Tenders will be called for within the next six or eight weeks.

White Point, N.S.—Contract let by Dominion Department of Public Works to A. W. Girroir and W. F. McKinnon, Antigonish, N.S., for breakwater extension.

Tenders Called For

TENDERS FOR PUMPING EQUIPMENT

CITY OF ST. THOMAS, ONTARIO

Tenders will be received by the undersigned until noon, Tuesday, December 30th, 1919, for the installation of Electric and Gasoline Auxiliary Pumping Equipment for the St. Thomas Waterworks. Bidders may tender on either Electric or Gasoline Equipment, or both.

Plans and specifications may be obtained at this office. Lowest or any tender not necessarily accepted.

W. C. MILLER, City Engineer.

December 11th, 1919. 392

TENDERS FOR PUMPS

Tenders will be received by registered post only, addressed to the Chairman, Board of Control, City Hall, Toronto, up to 12 o'clock noon on Tuesday, February 10th, 1920, for the supply and installation of:—

Tender No. 36—One or more 16 to 20 Million Imperial Gallon Centrifugal Pumps at the Waterworks Main Pumping Station.

Envelopes containing tenders must be plainly marked on the outside as to contents. Specifications and forms of tender may be obtained at the Works Department, Room 12, City Hall. Tenders must comply strictly with conditions of City By-law as to deposits and sureties, as set out in specifications and forms of tender. The lowest or any tender not necessarily accepted.

T. L. CHURCH (Mayor),

390 Chairman, Board of Control.

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WANTED, POSITION with large firm of contractors as purchasing agent, material man or stores supervisor. Broad experience. Can furnish best references. Box 41, *Canadian Engineer*, Toronto.

ELECTRICAL ENGINEER.—Several young graduates in electrical engineering, preferably with some shop or testing experience. Write Plant Department, Southern Canada Power Co., Ltd., Coristine Building, Montreal, Que. 389

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TAKE NOTICE that the Bennett & Wright Co., Limited, of the City of Toronto, Canada, duly manufactured the hot water heater covered by Canadian Patent No. 107,120 prior to the period called for by the Patent Act, and on application to the undersigned any further orders for the above invention will be filled at a reasonable price. Ridout & Maybee, Kent Building, Toronto, solicitors for Anders B. Reck 391

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The Canadian Engineer

A Weekly Paper for Civil Engineers and Contractors

Mining Methods and Tunnelling at the Front

Underground Adventures with Second Canadian Tunnelling Company—Defense of Mount Sorrel—Construction of Galleries and Dugouts—Surveying Under Difficulties—Experiences at Listening Posts—Light Charges in Bore Holes Rout Enemy Listeners

By CAPT. JAS. A. KNIGHT, M.C.

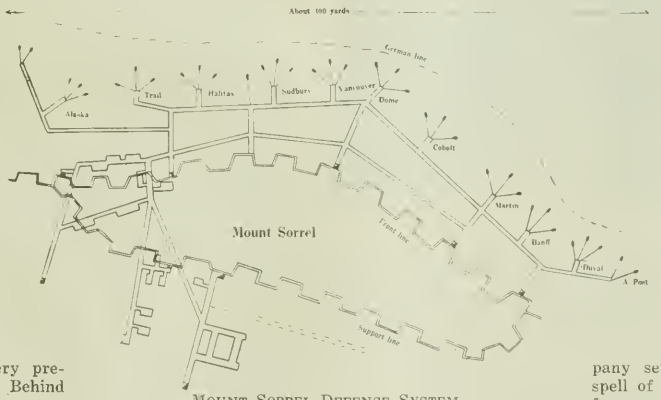
Formerly with the Second Canadian Tunnelling Company

THE Second Canadian Tunnelling Company arrived in France in March, 1916, all the personnel being drawn from the Canadian mining camps. My personal knowledge of the company dates from July 1st, 1916, when I joined it on transfer from the cyclists. On June 2nd, 1916, when the Germans launched an attack on Sanctuary Wood, this company was mining in the front line and had about 50% of its personnel rendered casualties. It was then withdrawn and reorganized, and several of us were taken on as probationers for commission, as the supply of mining officers was very low. I was first given one stripe and a gang of fourteen men, working at the reclaiming of some old saps which had been captured by Heinie and later retaken by our Second Division. As soon as we had living quarters arranged, we commenced to drive towards the German line, as we wanted to get a protecting gallery around the high ground known as Mount Sorrel, about 1½ miles south-east of Ypres and only 200 yds. to the left of Hill Sixty.

Our infantry had such a precarious hold on the edge of Mount Sorrel that every precaution was necessary. Behind us was nothing but low swamp through which it was quite impossible to make trenches. The natural thing for Fritzie to do was to try to blow us off the edge, and figuring that he would do the natural thing, we were ordered to put in a protective gallery to keep him back. Finding that our progress was too slow, the O.C. ordered us to start an incline from the front line, and we had no sooner reached the desired level (25 ft.) and commenced to drive horizontally than we ran into one of Fritzie's surprises, and he blew us, killing five men and wrecking our stair. This was very serious, as it showed us that he was already almost under our trench, and also was suspicious of us.

We then went about thirty yards to the right and left and started two inclines. Great care was taken to keep these saps secret, and strict quietness enforced. These were both driven down to the level required and galleries were driven out about 30 yds. We were then ordered to cross cut and connect. As these cross-cuts were expected to cut his gallery, our job was not very inviting, as we expected that he was patiently waiting for us to get near again to repeat his former kick. The officers in charge of this work adopted a very novel scheme which, although daring, worked all right. Work in each face would be stopped while a small bore hole was teased ahead about 25 ft., angling slightly outwards, then a very light charge would be placed in this hole and blown. Figuring that any listeners in the enemy galleries would have been chased away by the sound of the blow, our men would work like fiends for a couple of hours, when the ruse would be repeated.

In due course we cut his gallery and connected up our two stairs without losing another man. In this case our officers simply gambled on the probable effect of the blows on the Huns' actions and we won. It was considered quite a feat. After this the belt was continued with varying success till all the high ground was protected, about fifteen small mines being blown by each side. Sometimes Heinie caught some of our men, but we finally got the system finished as shown on plan. After this the company settled down to a long spell of fighting the Hun back from our line till June 7th, 1917, when, at the battle of Messines Ridge, every large mine on our front was successfully blown and tunnelling was ancient history.



MOUNT SORREL DEFENSE SYSTEM

While work was proceeding in offensive mining, the greatest thing necessary was to hear the enemy and not to let him hear us; therefore quietness was essential. This need of silence was the main reason why no mechanical devices were used. No one was permitted to wear boots in the galleries, the men mostly using sandbag slippers which they made themselves. The tunics were left off for fear the buttons would rattle on the timber, and all tools, timber, etc., which were carried through were swathed in sandbags to deaden any sound. No talking above a whisper was allowed.

Every 50 ft. along the main gallery, small listening pockets were driven off and bore holes radiated from the end. At the end of each bore hole there was placed a sealed torpedo containing 100 lbs. of ammanol, with an electric detonator and leads, and main leads were stretched down the main gallery from the office. Also each pocket had an electric

push-button connected to the office. Listeners lay in each pocket continuously, working in shifts of six hours on and twelve off. Each man had a geophone, which was a round wooden box, 3 ins. in diameter and 1 in. thick, containing a mass of mercury between two mica diaphragms, with ear connections like a doctor's stethoscope.

These geophones were very sensitive, and a good listener could pick up sounds of careless working through 16 or 20 ft. of sand, depending on its density. Practically the limit of hearing with the naked ear was 3 or 4 ft. Of course, in clay these distances were often much greater.

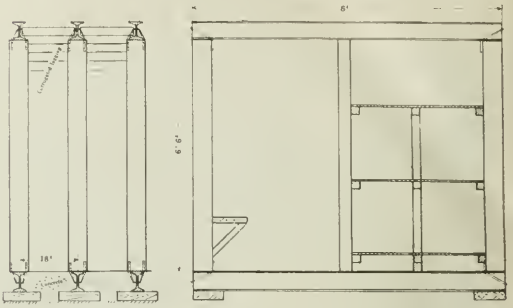
The leads from the torpedoes were carried out in gas-pipe tubes for protection, and if the geophone was placed in touch with the metal, the sounds were carried much better, so that when a listener heard a sound, he tried each pipe in turn, thus getting some idea of the direction of the sound. He then rang the bell, and either the officer on shift or the listening patrol would join him and confirm the sounds. Then the pockets on each side would be carefully tested and the source of the sound estimated. It was then necessary to determine whether the sound came from below or from above ground. This generally meant a few hours at night spent crawling around among the wire, etc., of No Man's Land to make sure the sounds did not come from wiring parties, or trench digging, or any other of the numerous noises of the night between the lines.

Entrance to German Gallery Near Vis-en-Artois

When we were quite sure that the enemy was underground, we noted the sounds in the log and waited. When he got close enough that we could hear him with the naked ear, we quietly stole away, connected up the main leads, tamped the gallery a little to secure it, and pressed the exploder. If we had been right, investigation would reveal our gallery all O.K., therefore the charge must have gone into the enemy's gallery, and the O.C., after investigation, patted us on the back and told us what fine fellows we were. On the other hand, if we found our own gallery smashed, it showed that we had had our "wind up" and blown a mouse or some other harmless noise, and the O.C. would say, "Hum! I guess Redan needs a new man. You ought to be retired in disgrace to a job where Fritzie couldn't reach you underground and given opportunity to think of your past failures."

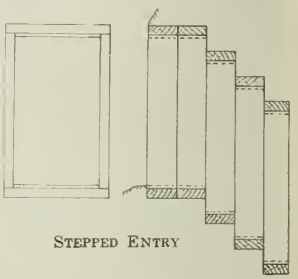
My greatest scare came from a mouse which had got down a bore hole; the rattle of its claws on the pipe exactly resembled the muffled scrape of a shovel. I had been called down by the listener and had lain in the dark for about two hours waiting for time to blow, the arrangement being that I would connect the leads, press the bell and the office would give me one minute to get back to safety before they would touch her off. However, when I had the leads all bared ready to connect (and I must admit that my hair was standing on end and I was sweating profusely, as I was quite sure Heinie was only three feet away), much to my relief I saw a small pink nose and two sharp ears appear at the mouth of the hole.

The desire to let the enemy get as close as possible, matched against the necessity of not letting him get in, to-



Type of Living Gallery Built by Canadian Troops

gether with the intense quiet and darkness, made the work extremely nerve-racking, and many men could not stand it for over three months. One night one of our men was too cautious about blowing, and Fritzie actually stole one of our torpedoes. Why he did not blow us we never knew, but he never got the chance again, as our flanking torpedoes were immediately blown, and as our gallery was untouched, we must have got him.

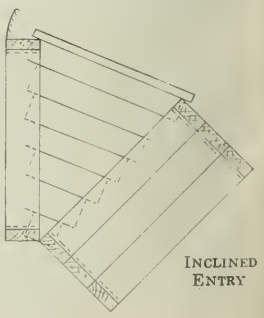


Stepped Entry

After a blow, very often the galleries would be filled with carbon monoxide, which is deadly, and so great precaution was always taken, a "proto man" being the first to enter the galleries after any trouble. The "proto man" was a man trained in the use of the proto, or mine-rescue apparatus. He usually went armed with oxygen tank on his back and a canary in a cage. If the canary fell off the perch, he knew there was carbon monoxide present, so he would strap on his mouthpiece, if it were not already on, and finish his investigation with artificial air.

Methods of Mining

The timber used in France for mining purposes was standard 3 by 9 in. spruce and pine, with some local elm when the supply ran short. Standard sets were made up in the yards, the inside dimensions being 2 ft. 3 ins. by 4 ft., 2 ft. 6 ins. by 5 ff., 2 ft. 6 ins. by 5 ft. 6 ins., 3 ft. by 6 ft., and 6 ft. 6 ins. by 6 ft. Most mine galleries were 2 ft. 3 ins. by 4 ft., and connecting galleries, 2 ft. 6 ins. by 5 ft. or 5 ft. 6 ins. Main galleries for passage of troops were generally 3 ft. by 6 ft., and living dugouts, 6 ft. 6 ins. by 6 ft.



Inclined Entry

In shallow work, that is, with less than 30 ft. of head cover, sinking and rising was carried out by the use of stairways and not shafts, 2 ft. 6 ins. by 5 ft. 6 ins. or 3 ft. by

6 ft. timber being used if the sets were stepped down, and 2 ft. 6 ins. by 5 ft. if the timber were set in the incline and steps placed later. This latter method was used by our company near the end of our work, as we found it the quicker method and also easier for keeping line and elevations. The sets of timber were made up of two legs and two caps or sills.

The caps and sills were supplied with spreaders nailed to the 3 in. by 9 in. timber against which the legs set, and so no nails were necessary to set the timber. The ground excavated was just a neat fit, except over the cap, which was one inch slack to allow for setting.

The Germans used a mortised end on their caps and legs, consisting of a ⅓ tongue, but this required a larger cut, and also was more noisy to handle, as they secured them with wedges, although this was not really necessary. We never made a practice of bracing the galleries, but in the dugouts, which were generally 6 ft. 6 ins. by 14 ft. long, we placed a centre support of two 3 in. by 9 in. timbers on edge, with 6 in. by 9 in. posts at centre and each end. Later, we placed a system of spreaders on top and bottom in order to resist the rebound or bump caused by the explosion of shells right overhead. The failure of many galleries and dugouts was due to the legs jumping the spreaders after a blow.

Construction of Galleries

When the ground was satisfactory, sets consisting of 8 ft. I-beams supported on pit props and secured to them by means of cast-iron chairs or hairpin clips (which were best, as they resisted bumping, which the cast-iron chairs did not), were placed at about 18-in. centres and then "lagged" with corrugated iron. This made a very roomy gallery, which we bunked with lumber and wire, three tiers of bunks, two-man wide, accommodating six men every 6 ft. 6 ins. of gallery. Some of these were concreted, and by driving air shafts to the surface about every 40 ft., we got very good ventilation.

When deep shafts were being sunk through quicksand, 4 ft. or 6 ft. steel tubing was used, the flanges being inside. This tubing was supplied in three segments. When the ground was good, these were sunk by digging out below and jacking down by the use of screw-jacks, the successive tiers of steel being bolted on at the top. The lower set was supplied with a flanged cutting edge. When quicksand was encountered, the whole thing was jacked down until solid ground was reached. As I never worked in a deep shaft, I cannot give a very accurate description of the difficulties met with in this work, although line was very hard to keep, due to a slight movement which sometimes existed in the sand, especially near the canal south of Ypres.

After the shaft had been sunk well into the clay or hard sand at the level desired, one segment of the lower tiers could be dropped out, leaving an opening to start the drift, or drive. Line was kept by the use of cross levels on the top, and also checked with a plumb-bob. The difficulties encountered in driving level and using timber sets were mainly due to quicksand just below the sills, and also to broken or shaken ground above the caps leading to a lost roof or cave-in.

Fore-Poling and False Sets

When the roof was allowed to drop, a method known as fore-poling was necessary in order to recover a solid roof. This consisted of driving stakes into the solid face in front, at an elevation above the top of the caps, and catching them on the top of the last set placed. Then the cavity was filled up with spoil in bags and packed until the roof was reached. The gallery would then be continued, the sets being placed under the poles which steadied the roof. If the cavity was not packed tightly, the roof would continue to shell off as fast as the face was removed. At times the ground at the face would not be strong enough to carry the fore-poling, in which case what was known as false sets would be used. They were sets placed inside the last set of the gallery, and sufficiently small to allow about 1½ ins. clearance, top and sides. Long lagging would then be driven through between these sets, angling outwards. After this timber had been driven sufficiently far into the ground ahead, wedges were driven between the inside ends of the lagging and the gallery timber. Thus the ground in front was held in place by the cantilever action of the lagging. The trouble with this method of procedure was that the gallery was very irregular in section, because the sets placed directly in front of the false set would be slightly smaller than the original section.

Pilot Galleries

Very often it was found very hard to drive a large face, although a small one would hold quite well. In ground of this nature a small gallery known as a pilot was used. This method consisted of driving a small gallery about the centre of the main face, and afterwards returning and enlarging it to full size, using the pilot timbers to steady the ground in front. In one case I found it necessary to use a second pilot, and as the gallery in question was being driven through a graveyard, the rum jar was a very necessary friend. A shot of rum every half hour barely sufficed to deaden the stench.

Working conditions seldom allowed one to pick his sight. In one connection made by our company it was found necessary to use false sets and to fore-pole the floor as well as the top and sides, the ground being semi-quicksand. Working in this ground was very unsatisfactory.

Vertical wooden shafts were sometimes used in good ground, the sets being placed at the bottom and hung by strapping to a collar set placed on the ground at the top.

So far I have only mentioned the difficulties met with due to the ground. It must be remembered that all the time the Hun was watching as closely as possible, and the moment he saw a bit of timber or fresh ground or blue clay, he turned all kinds of noisy messengers on to the locality. It was generally necessary to start work at night, and until every man was well below ground no work could be carried on in daylight, and all material would have to be carefully covered with sacking and sand before day broke. After sufficient cover was obtained, the spoil from the day shifts would be piled in the gallery in sandbags, and an extra party of men put on at night to clear it away and dump it, taking care to cover the fresh sand with surface sand before leaving.

Very often a face which seemed to be quite hard and firm would suddenly fall in, due to the shake of a big shell falling near, a condition never met with in civilian mining.

Surveying Under Difficulties

Most of the time our surveying was done with 4-in. prismatic compasses, and as some of the galleries were lined with corrugated iron, and dud shells were likely to be on any side of one, it can be seen that connections were very often made largely by guess. After our second year, however, we managed to get an excuse for a transit and a very good dumpy level, so we were able to make a few decent-looking connections.

The Dominion Iron & Steel Co., Ltd., announces that it has received an order from Rumania for 7,500 tons of specially shaped rails. Work on the order will commence in January.

The Asphalt Association, which has had temporary offices at 56 Church St., Toronto, for the past few months, has obtained permanent quarters in the Tyrrell Bldg., 95 King St. E., Toronto. The temporary telephone numbers are Main 4288 and 4289. The office is in charge of Bruce Aldrich, district engineer for the association.

The following officers were chosen by the Town Planning Association of Southwestern Ontario to serve for the ensuing year:—President, Ald. John Bridge, Windsor; first vice-president, W. A. Childs, Hamilton; second vice-president, S. Baker, city clerk, London; hon. secretary, Gordon Philips, London; hon. treasurer, John Cottam, London; executive committee, F. Maclure Selanders (Border Cities), J. McAdam (Sarnia), W. B. Burgoyne (St. Catharines), J. M. Shuttleworth (Brantford), and W. H. Breithaupt (Kitchener).

LARGE SHEAR-LEGS BUILT AT TORONTO

SHEAR-LEGS 80 ft. high, 35 ft. wide at the base, 10 ft. wide at the top, and with carrying capacity of 100 tons distributed equally between two blocks, were recently erected at the yards of the Dominion Shipbuilding Co., Toronto.

The two blocks allow both symmetrically and eccentrically loaded machinery to be carried horizontally with equal facility. The top girder also carries an auxiliary fall, of 10 tons' capacity, to take lighter weights.

The main legs are hinged at the bottom and allow the shear legs to tilt forward to a maximum, when loaded to capacity, of 50 ft. overhang from the base. When carrying 50% of the full load, the overhang may be increased to 60 ft. The 50-ft. overhang is sufficient to allow machinery to be placed in the centre of a boat or on the side away from the shear-legs.

In order to obtain strength without excessive cost, latticed steel construction was decided upon for both main

SHEAR-LEGS BUILT FOR DOMINION SHIPBUILDING CO.

and back legs. The top girder is of steel plate. The main legs have a maximum dimension of 4 ft. square at the middle, tapering to 18 ins. square at the ends. All the legs are strengthened by diaphragms.

The shoes and hinges are of cast steel and are embedded in concrete. The back guys are 2-in. plough steel cables, which are each attached to a quadruple luffing tackle which is anchored to a 4-in. steel pin buried 10 feet deep in concrete.

The steel hoisting blocks are 15 ins. in diameter. Each of the four 50-ton blocks have six sheaves, carrying ¾-in. plough steel cable. These cables are connected to the hoisting machinery by way of underground ducts.

The hoisting speed of the 50-ton blocks is 6 ft. per min., and they are operated by a four-drum electric hoist, equipped with a 60-h.p. motor. This hoist also operates the luffing tackle. Two drums of the hoist are in series and two in multiple. There is a special single-drum electric hoist, with a 60 h.p. motor, for operating the 10-ton block with speeds up to 50 ft. per min. These hoists have automatic brakes and band brakes on the drums. Cut steel gears were used throughout, with the exception of the main gears on the drums, which are of cast-iron.

The shear-legs were fabricated by W. D. Beath & Sons, Ltd., and McGregor & McIntyre, Ltd., both of Toronto and were supplied to the Dominion Shipbuilding Co. through

VIEW SHOWING HOIST HOUSE AND LUFFING TACKLE

F. H. Hopkins & Co. The design was suggested by the engineering staff of the Dominion Shipbuilding Co. and was detailed and elaborated by C. V. Osborn, Toronto manager of F. H. Hopkins & Co., and by Harry Brass, engineer for W. D. Beath & Sons, Ltd.

At the annual meeting of the Border Cities branch of the Engineering Institute of Canada, the following officers were elected: Chairman, H. B. R. Craig; secretary-treasurer, J. E. Porter; executive, J. J. Newman, H. Thorne and Ed. Brain.

J. M. Leamy, provincial electrical engineer of Manitoba, states that construction on the first lignite briquetting plant in Western Canada will commence early in the spring. The plant will be located six miles southeast of Bienfait, Sask., on a spur of the C.P.R. All the buildings will be of steel construction.

With the object of promoting a highway from Fort William to Winnipeg, a new organization, to be known as the Central Canada Colonization and Highway Association, has been formed. Out of a total mileage of 423 miles, 60% will have to be brought up to a "good roads" standard and connected to sections already constructed. The suggested road would open about 50,000,000 acres of land that are at present undeveloped.

In Alberta and Saskatchewan, about 54,000,000 acres of land require irrigation, says the superintendent of the Dominion reclamation service. A further area of 19,000,000 acres, lying between the North and South Saskatchewan and the Battle and Deer rivers, is declared by engineers to be irrigable. At the present time about 1,500,000 acres are irrigated, and the Dominion government has promised immediate surveys of another 500,000 acres which will be irrigated at an estimated cost of $20,000,000. The Canadian Pacific railway has developed in Southern Alberta the largest individual project on the American continent, with an irrigable area of 600,000 acres, and canals and ditches having a total length of over 3,000 miles.

$6,000,000 SEWERAGE SCHEME RECOMMENDED FOR WESTERN PART OF YORK TOWNSHIP, ONT.

COMPLEMENTARY to the report on the sewerage scheme for the eastern division of York Township, Ont., which was published in last week's issue of *The Canadian Engineer*, is the report which has just been submitted by the township engineer, Frank Barber, and his associate, R. O. Wynne-Roberts, planning a sewerage scheme for the western division of the township at an estimated expenditure of about six million dollars. The following information is abstracted from the report:—

The topography of the western division, which includes that part of the township from Oriole parkway on the east to the Humber river on the west, but excludes the subdivisions which are located north of St. Clair avenue, Toronto, near Jane street, is such as to render it impossible to design a scheme similar to that proposed for the eastern division, where the engineers recommend one large sewerage system capable of being divided into sections which could be constructed as required. The general inclination of about half of the western division is south and southeast towards the city of Toronto, the other half tending to fall southeast towards Black creek.

It would be impossible to drain the sewage and roof water from most of this division towards Black creek, but when storm water has also to be disposed of, then the dimensions, and therefore the cost, of the sewers become prohibitive. Consequently, it has been considered advisable to split the division into ten sections, of which all but one will have a combined system of sewers for sewage and storm water.

The proposed sections, which are localized by their names, are as follows: (1) Bathurst, (2) Cedarvale, (3) Oakwood, (4) Silverthorne, (5) Eglinton, (6) Roselawn, (7) Bedford Park, (8) Upper Black Creek, (9) Lower Black Creek, and (10) Mount Dennis.

1. The Bathurst section, which is described as the district lying east of Forest Hill road and Bathurst street, from the vicinity of Upper Canada College to Wilson street, has an area of 1,030 acres, and drains naturally towards the city of Toronto by streams flowing southeast to the Don river.

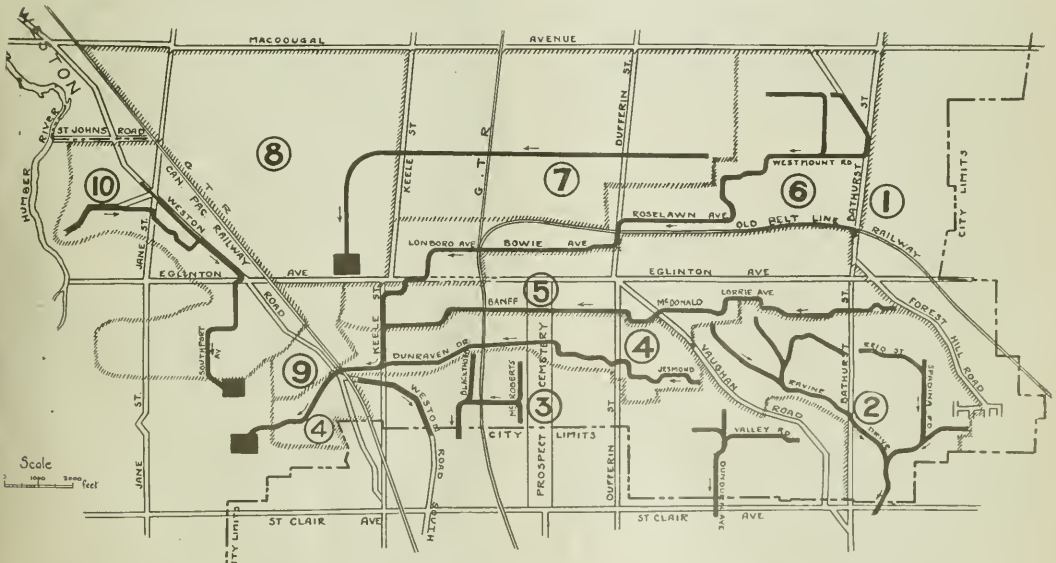
The watersheds of these streams have a total area of 3,544 acres, and are tributary to the natural water-courses passing through North Toronto. As provision was made for the drainage of the natural run-off from these watersheds into the proposed trunk sewers for the North Toronto drainage system, the engineers recommend that the Bathurst section should be sewered into the city system.

The estimated cost of sewers is $920,000 for trunk sewers and $616,000 for laterals, which, based upon 30-year 6% debentures for trunk sewers and 10-year 6% debentures for laterals, would indicate an annual capital cost of $149,000, or $112,000 if based upon 30-year 6% debentures for the whole work. On a frontage basis, this amounts to 48 cents and 37 cents per foot respectively, and adding the city's present charge of 23 cents per foot for outlet rental and maintenance, the amount is 71 cents per foot per annum.

2. It is proposed that the Cedarvale section shall extend from Forest Hill road on the east to Vaughan road and Oakwood avenue on the west, and from the Toronto city limits on the south to Dearborne and Lorrie avenues on the north; this comprises about 530 acres. The natural outlet for the sewage and storm water is to Rosedale creek, and the works commissioner of Toronto stated in 1915 that a portion of the section could be drained into the Rosedale creek sewer.

The total area of the watershed of Rosedale creek is 2,100 acres, with a runoff towards the city of Toronto. The city authorities are bound to accept the natural flow, but they contend that they are not responsible for the disposal of sewage or streams when houses are built and streets are graded and paved. The York Township engineers consider that the city of Toronto should provide outlet facilities for the sewage and storm-water from the Cedarvale section, with the understanding that three trunk sewers shall be constructed across the watershed when required in the future, namely, on Dearborne and Lorrie avenues for the Eglinton section, on Roselawn for the Roselawn section, and on Park road for the Bedford Park section, these trunk sewers to act as interceptors and to divert the storm-water to Black creek, thus limiting the discharge into the city of Toronto to that from the Cedarvale section solely.

The cost of sewers in the Cedarvale district is estimated at $422,000 for trunk sewers and $342,000 for laterals, with an annual capital cost of $77,000 or $56,000 (equivalent to 50 cents or 37 cents a foot), depending upon whether 30-year 6% debentures are considered for trunk sewers only or for the whole system. The addition of the annual charge of 23



PROPOSED SEWERAGE SCHEME FOR WESTERN DIVISION OF YORK TOWNSHIP, ONT.

cents, which may be increased, brings the estimated cost of construction of these sewers to 73 cents per foot frontage per annum.

3. The Oakwood section comprises the area lying between Vaughan road, Wilmington, Hanson, Donald, Eversfield, Hatherly, Summit and Aileen avenues on the north, Bathurst street on the east, the Toronto city limits on the south, and the railway on the west.

It is stated that nineteen avenues have sewers for part or the whole of their lengths, and as it is considered inadvisable to make any change which would complicate the system, a recommendation is made that the sewers required for the remainder of the streets in Oakwood section should connect with the city sewerage system. About 520 acres in this district must be sewered at a cost of about $520,000, or an annual capital cost of 44 cents per foot frontage on a basis of 10-year 6% debentures. The total charge, including the rental, amounts to 67 cents per foot per annum.

The points of connection can be arranged to suit the city sewerage system, but the tentative location of these connections are shown in the accompanying plan. The works commissioner of Toronto has stated that the city can accommodate the combined flow from about 204 acres, but it would be necessary for the township authorities to construct a storm sewer paralleling St. Clair avenue from Ossington avenue to the Rosedale creek sewer.

4. The Silverthorne section, with an area of 360 acres, must be drained into Black creek, and for that purpose a trunk sewer is proposed, to be built along Wilmington, Jesmond, Harris, Westmount, Martin, Holmesdale, Chudleigh and Harvey streets, thence to Dunraven, Keele, Elora and Northland streets, with a storm sewer relief to Black creek which will intercept another storm sewer flowing from the north.

The cost of this scheme will be approximately as follows: Trunk sewers, $364,000; laterals, $219,000; share of cost of disposal works, $110,000; total, $693,000.

The annual capital cost is estimated at $64,000, or 59½ cents per foot when based on 30-year 6% debentures for trunk sewers and 10-year 6% debentures for lateral sewers, and $51,000, or 47 cents a foot when calculated upon a basis of 30-year 6% debentures for both.

5. The proposal for the Eglinton district, including 620 acres, includes a trunk sewer (with an outlet at Black creek) flowing along Dearborne, Pellatt, Sutherland, Lorrie, Clovelly, Leroy, Carrington, Banff, Commodore, Silverthorne, Ewart and Keele streets, and joining the sewer from the Silverthorne section at Dunraven avenue, with a storm water relief to Black creek. This will intercept the storm water and sewage flowing to the north as far as the Belt Line and Bowie avenue.

The estimated cost of this scheme is: Trunk sewers, $632,000; laterals, $422,000; share of cost of disposal works, $190,000; total, $1,244,000.

The annual capital costs, figured on the same basis as for previous sections, are $112,000 or $91,000, or (expressed in terms of foot frontage) 60 cents or 49 cents.

6. Roselawn district similarly drains to the Upper Black creek, and a trunk sewer is suggested along Roselawn, Bowie and Lonborough avenues, discharging into the disposal works on the creek. A subsiding trunk sewer will follow Fourth street, Stayner and Summerhill avenues and Westmount road. The total area to be drained is 630 acres.

7 and 8. The township engineers consider that sewers for the Bedford Park and Upper Black creek districts, the former with 860 acres and the latter 1,000 acres, would be very far in advance of present needs, and as conditions may change in those sections before the sewers are required, no estimates have been presented for those two districts. The engineers state that the main feature to be established is the trunk sewer, and the direction of this is indicated on the accompanying plan.

9. The Lower Black creek section has an area of 100 acres, and is bounded on the north by Eglinton avenue; on the south by Elora to Cripps; on the east by Walter, Juliet and Bicknell avenues; and on the west by the railway tracks to Jasper and Symes avenues.

The section is too low-lying to permit the sewage being discharged by gravity into the trunk sewers which pass in the vicinity, and pumping will be required at the disposal works. The estimated cost of this scheme is about $145,000, as follows: Trunk sewer, $20,000; lateral sewers, $60,000; pumps and wells, $5,000; share of cost of disposal works, $30,000; storm sewers, $30,000; total, $145,000.

Estimating the annual fixed charge on a basis of 30-year 6% debentures for trunk sewers, disposal works and storm-water system, and 10-year 6% debentures for laterals, pumps and wells, with a maintenance, power and repair charge of $2,200, it amounts to $16,661, or $13,043 if on a basis of 30-year 6% debentures for all works. The estimated cost per foot frontage is 55 cents in the former case and 44 cents in the latter.

10. The Mount Dennis district includes all the territory west of the railway tracks, south of Weston limits, east of Humber river and north of Black creek, and has an area of 440 acres exclusive of low-lying gardens. It is proposed to drain this area to a disposal plant situated in the Black creek valley, to the north of the creek and east of Southport avenue. The estimated cost of the scheme is $836,000, and the annual capital cost would be about 59 cents per foot of assessable frontage, or 45 cents per foot if the laterals be based upon 30-year debentures.

When the flow of sewage exceeds three to six times the average flow, the surplus will, where possible, be discharged into relief sewers, but the cost of these are not included in the foregoing schemes, because the sewers already designed are ample for a long time.

The surplus over six times the normal flow will be discharged into the stream, which will at that time be in flood, and consequently no harm can then be done. Consideration was given to every means for enabling all the sections to have one joint sewage disposal works, but this had to be abandoned owing to the difficulties of arranging for the trunk sewers to cross the different valleys at satisfactory grades and on account of the cost of such trunk sewers.

Consequently, at present it seems necessary to have two disposal plants for the western division, one in the Lower Black creek valley for the Silverthorne, Eglinton, Roselawn and Mount Dennis sections, for which 20 acres of land will be necessary, and one in the Upper Black creek valley for the Bedford Park and Upper Black creek sections, which will require about 18 acres of land.

The method of treating the sewage will be either by means of tanks and filters or by the activated sludge process. The disposal works will, of course, be built according to the requirements from time to time, and the whole sewerage scheme is so arranged that any portion can be carried out, provided the work proceeds from the outlets. The entire works will not be completed for several years at least, but it was deemed advisable by the authorities to have comprehensive plans outlined for the sewerage of the entire township, so that any sections that are built will fit into a definite general scheme.

Representing 53 boards of trade, the annual meeting of the Ontario boards of trade adopted without opposition a resolution urging the desirability of the Ontario government's carrying on a highway scheme "until the province is a network of good, substantial roads serving the communities with economy and efficiency, and adding greatly to the comforts of life."

The Light Commission of Kitchener, Ont., which operates the electric and gas plants, as well as the Kitchener & Waterloo street railway, states that it has to solve the problem of providing within the next few months at least 100% more power than is at present supplied. The members are opposed to the hydro-radial by-law, which is to be voted on on New Year's Day, being of the opinion, that when the Chippawa development is completed, the demand for domestic, commercial and industrial power will utilize the 450,000 h.p. that will be developed, without radial railways.

G. B. GREENE HEADS OTTAWA BRANCH, C. B. & C. I.

AT the annual meeting of the Ottawa branch of the Association of Canadian Building and Construction Industries held December 10th, G. B. Greene, general manager of the General Supply Co. of Canada, Ltd., Ottawa, Ont., was elected president.

Other executive officers chosen for the ensuing year were: Vice-president, H. Graham (general contractor), J. L. Douglas (trade contractor) and R. Hooper (supply man); honorary treasurer, E. M. Barrett; and honorary secretary, G. A. Crain.

In addition to many prominent contractors, there were present several members of the Board of Trade, including the secretary, Cecil Bethune, and E. R. Bremner, both of whom addressed the meeting. F. B. Belfry spoke on behalf of the Ottawa Housing Commission, urging greater interest on the part of contractors in the work of that body.

TORONTO HARBOR COMMISSION'S WORK

BETWEEN the years 1912 and 1918 the Toronto Harbor Commission accomplished works amounting to $9,764,800. From the Dominion government 257.5 acres of water lots were acquired by patent; the commission also acquired 4,700 ft. of frontage or riparian or water rights between Bathurst and York streets. Business and industrial properties and parks required the handling of 16,000,000 cu. yds. of material in reclaiming 1,057 acres of water lots and marsh lands.

Approximately 2½ miles of commercial dock walls were constructed, which, with the exception of the Don retention walls, are in the inner harbor.

At the eastern harbor terminal, the work done includes 11,630 ft. of sidewalks, 9,350 ft. of concrete pavements of various widths, 9,500 ft. of storm sewers from 12 ins. to 42 ins. in diameter, and 4,500 ft. of overflow sewers (sizes 6 by 18 ft., 6 by 16 ft., and 6 by 8 ft.).

NATIONAL HIGHWAY TRAFFIC ASSOCIATION

AT the annual convention of the National Highway Traffic Association, which is to be held January 29th, 1920, in Chicago, the morning session will be devoted to the reading of reports of committees on highway transport franchises; interrelationship of highway, railway and waterway transport; traffic limitation strips on roadway surfaces; and sign posting for detours and through routes to municipalities; and an address by George W. Tillson, consulting engineer, La Grange, Ill., on "The Effect of Car Tracks on Traffic Capacity of Roadways."

"Highways and Motor Transport" will be the general theme of discussion at the afternoon and evening sessions, which will be joint sessions of the National Automobile Chamber of Commerce and the National Highway Traffic Association. The addresses to be delivered include: "Taking an Interest in Motor Truck Legislation," by Harry Meixwell, Jr., secretary, Automobile Industries Legislative Commission, New York; "Value of Highway Transport Surveys," by F. Van Z. Lane, transportation engineer, Packard Motor Car Co.; and "Interrelationship between Highway Transport and the Back-to-the-Farm Movement," by L. C. Hargreaves, of the Goodrich Rubber Co.

Arthur H. Blanchard, of the University of Michigan, who is president of the association, will speak on the "Relation of Highways to Motor Truck Operating Cost," and William G. Edens, president, Illinois Highway Improvement Association, on "Progress in Highway Improvement."

"Constructing Roads for Motor Truck Traffic," is the title of a paper by Prof. T. R. Agg, Iowa State College. Raymond Beck, chief of the Goodrich National Touring Bureau, will discuss the "Status of Legislation Relative to Snow Removal from Interstate and Intrastate Highways."

COMPUTING CROSS-SECTION AREAS BY THE METHOD OF CO-ORDINATES

By J. A. McDonald
Provincial Land Surveyor, Hermanville, P.E.I.

IN spite of its simplicity, the computation of areas by the method of co-ordinates is not often practised by engineers and surveyors. In the following article a formula is obtained for a given area in terms of its co-ordinates, and a general formula derived which is applicable to a cross-section area of any shape.

Referring to Fig. 1, the area of the figure 1234 is equal to the trapezoids $(a12b)+(b23c)-(a14d)-(d43c)$.

Expressed as an equation in terms of the co-ordinates:—

$$\text{Area } 1234 = (y_1-y_2)(x_1+x_2)/2+(y_2-y_3)(x_2+x_3)/2-(y_1-y_4)(x_1+x_4)/2-(y_4-y_3)(x_4+x_3)/2$$
$$= \tfrac{1}{2}[y_1(x_2-x_4)+y_2(x_1-x_3)+y_3(x_4-x_2)+y_4(x_1-x_3)].$$

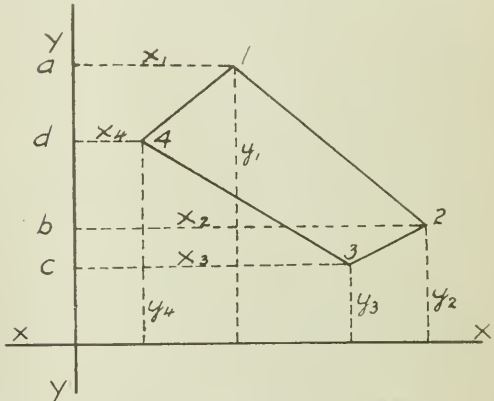


FIG. 1—DIAGRAM FOR CALCULATING AREA BY METHOD OF CO-ORDINATES

From this equation is derived the following rules for obtaining the area when the co-ordinates are given:—

(1) Number the corners consecutively.

(2) Multiply each ordinate by the difference between the abscissae of the points preceding and succeeding, and take half the sum of these products.

The adoption of this method in computing railway and other earth cross-sections is quite simple. The cross-section

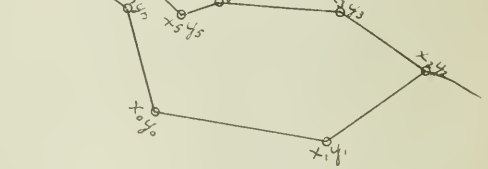


FIG. 2—DIAGRAM SHOWING GENERAL APPLICATION OF FORMULA

is considered as an area all of whose co-ordinates are known; the cuts or fills are represented as ordinates and expressed in terms of y, whilst the distances out from the centre become abscissae, and are expressed in terms of x.

The general formula for any possible shape of cross-section whose area is A would be (Fig. 2):—

$$A = \tfrac{1}{2}[y_1(x_1-x_n)+y_1(x_2-x_1)+y_2(x_3-x_1)+y_2(x_1-x_2)+y_3(x_5-x_3)+y_5(x_6-x_4)+y_6(x_7-x_5)+y_7(x_8-x_6)+y_8(x_9-x_7)].$$

The application of this formula is by no means so difficult as the formidable appearance of the above algebraic statement would indicate.

When making use of this formula, it may be advisable in figuring the first few sections, to draw rough sketches of the sections in order to ensure taking the points in correct order; a very little practice will enable an engineer to compute the areas directly from his cross-section notes.

The formula is not an approximation, as are the slope and other formulæ, but is mathematically exact and applicable to every kind of section.

The following directions should be followed:—

"Begin at any point on the section and proceed in either direction (clockwise or counter clockwise), multiplying each cut (or fill) in its order by its horizontal distance between the point just preceding and the point just succeeding. In cases where one passes to the right in measuring the horizontal distance from the preceding to the succeeding point, the product obtained by multiplying this distance by the cut (or fill) at the intermediate point is of one sign, and in cases where one passes to the left, it is of the opposite sign. Take one-half the difference between the sums of the products of opposite signs, and the result is the area of the section."

Thus, in a side-cut where only the slope stake reading and the intersection of the earth surface with the grade-line are taken, the area is a simple triangle, and the application of the formula to the computation of the area would seem to require three multiplications.

Two of the points, however, are on the grade-line and the cut (or fill) is zero, hence the product is zero; the formula, therefore, results in a single multiplication and taking one-half the product of the cut and width.

In the case of the so-called "three points" or "three level" section, which is a section actually containing five points, two multiplications are eliminated in a similar manner.

The outside slope points can be worked together by taking the sum of these cuts (or fills) and multiplying by one-half the width of the roadbed.

Many useful and interesting features of the application of the formula become apparent as its use is extended.

Letter to the Editor

TRADE UNIONISM AND ENGINEERS

Sir,—I have read, with much interest, the letter on "Trade Unionism and Engineers," by Fred Christie, in your issue of December 18th, and I think he voices the sentiments of all engineers who do the work and are not the engineers who employ other engineers.

Mr. Christie is evidently not of that class of engineers who are afraid to speak of conditions as they exist. The engineers at present supposed to be in the control of the large engineering societies are mostly in the employ of corporations or are employers of engineers of their own. Many of the so-called leading engineers are "leading" because they control the living of other engineers, and the leaders could not hold their jobs unless they kept wages down.

If engineers are afraid of trade unionism, what about the methods that are used against them? These are the old methods used against the union men in former years, but which the employers no longer dare use. For instance, thirty of the leading engineers wanted to have a committee meet their employer and discuss pay. Would he receive the committee? Not so that you would notice it. He received the paid representative of the men who cleaned out his premises, but not the committee of his engineers.

The pay of the engineers has been raised less than 20%, while the scavenger has been raised 150% or more, and in some cases is getting nearly as much as the engineers. Force must be met with force, and the individual engineer negotiating with the employer is a joke. The engineer has no business education, is usually in debt for his schooling, and has a family, but in general has to assume the attitude of a supplicant instead of a freeman.

Some engineers are now in charge of $2,000,000 worth of various work in a year, and get less than $3,000. I paid an armature winder $66 for last week's work and hope to pay him more next week; the more he makes, the more I make. But the machine he wound was designed by me on a $23-a-week salary and an education that cost me $10,000 and seven years' time! That was some years ago, but the engineers in the same place are really getting less than that now, so far as the purchasing power of their money goes.

Dignity is all right, but when you have to hold off the grocery man, dignity is no good. How can a man with a college education be dignified with from $1,500 to $3,000 these days?

A salary of less than $5,000 a year is no good for dignity, and few engineers are getting that or ever will get it until they belong to some organization with "sand."

The sooner the engineers join a union, the better for all,—employers of engineers included. A man cannot work when he is only one jump ahead of the sheriff.

Another thing is this: The employer, while he will not pay the experienced engineer a decent salary, will pay a set of dubs three times as much to do the same work; that is, he gets six men at a low pay to do one man's work, and pays them in the aggregate three times as much as he would have to pay the one man. This has happened and is happening many times.

Some big companies have engineers by the dozen doing work that anyone with even less than a high-school education could do. Of course, it is a good idea to have a lot of technical men doing clerical work; they know what the words mean; but clerical work gets clerical pay, no matter who does it, and until engineers doing clerical work catch onto themselves, so long will they get clerks' pay.

The remedy for this is to exclude clerks from engineering societies; they are doing menial work, and not engineering work. The idea is that they are in line for promotion, but for 95 out of 100 there are no good jobs.

In the average large engineering establishment there are not over three good paying jobs and they are held for 40 years or so by the same men. What chance is there of promotion?

Many engineers now make a specialty of marrying rich girls or daughters of their employers, and in this connection I have never known of an engineer who married the daughter of his employer who failed to have the best job in the place. I suppose the business acumen he displayed in getting the girl is what got him the job, but I doubt it.

Never have I known an engineer, a hired one I mean, to get a good job without some influence other than his ability. The members outside of the influential circle can get into one by some kind of an organization doing its business with a paid representative, and by no other way. The ordinary engineer negotiating with his employer on the salary question is a joke.

N. C. MILLS,
Vice-President and Managing Director,
Montreal Armature Works, Ltd.

Montreal, Que., December 20th, 1919.

During the fiscal year 1918-1919, work was done in the province of Quebec on 904 miles of road, which included 282 miles of completed roads and 292 miles of winter roads. An aggregate of 16,580 ft. of bridges and culverts were also built by the highways department. The total amount expended during the year was $530,935.

In order to provide water and electric power for Palestine, Albert Hjorth, a Norwegian engineer, suggests a tunnel 37 miles long, from the Mediterranean to the Dead Sea, passing under Jerusalem, with power plant on the shores of the Dead Sea, and a pumping station on the Sea of Galilee. The initial cost would be $40,000,000. The surface of the Dead Sea is 1,300 ft. below sea level, and that of the Sea of Galilee, 650 ft.

Economic Values in Sewage and Sewage Sludge

Grease in Dried Sludge, or Tankage, Makes Its Assimilation by Soil Very Difficult—Sludge Must Be Acidulated with Mineral Acid and Percolated—Adaptation of Cobwell Process—Address to American Society for Municipal Improvements

By RAYMOND WELLS
Chemist and Technologist, Homer, N.Y.

WHAT is sewage sludge? Is it just a plain nuisance—something to be sunk, burned or buried—or is it just a very unattractive mass of low-grade raw material offering slight potentialities in economic values, provided of course that they can be liberated?

Much sleep has been lost by enthusiasts in both directions. It is unnecessary to say that for many years the fertile brains of inventors, engineers and chemists have been directed toward methods of restoring to the economic cycle all or any portion of the values contained in sewage or sewage sludge. Unquestionably vast quantities of valuable materials are present in sewage, but so great is the dilution in the carrying medium, and so dangerous to the public health is any delay in rendering it innocuous, that methods of recovery so readily applied in other waste reclamation are not applicable to sewage or sewage sludge.

The net result of all labor and thought along this line seems to have been the accumulation of a great deal of knowledge of what cannot be done, and as yet there is no method in actual operation on a large scale for recovering anything of value, or indeed offering any reasonable disposition of the sludge problem.

The apparently most patent and logical disposal of sludge would be the direct recovery of manurial values by direct application to the land. Water, however, is an expensive thing to transport in wagon bodies, and a grease-soaked fertilizer is difficult of assimilation by the soil, and constant application of such material invariably destroys soil texture.

Partial elimination of moisture by bed drainage and drying, followed by incineration, has offered a more or less practical and expensive disposition of the sludge, with of course no values recovered.

Colloidal Character of Precipitate

Partial elimination of moisture by filterpressing or centrifuging, followed by drying, would seem to be the simplest method of putting sludge into a valuable form. But unfortunately the almost colloidal character of the precipitate and the amount of grease and metallic soaps contained render pressing and centrifuging below 75% to 80% of moisture a difficult task. The subsequent evaporation of so great an amount of water in any type of drier is most expensive and the odors given off are extremely disagreeable. Furthermore, in direct heat driers, the volume of gases of combustion, together with the moisture-saturated air, is so great as to preclude any thought of condensing or scrubbing out the odors. For this reason alone, aside from the difficulties encountered in drying such a material, it is difficult to see any hope of solution in this direction.

Furthermore the dried residue or tankage obtained by this method, while having considerable manurial value, is in a most undesirable condition for use as fertilizer or fertilizer base-goods. This is due to the grease contained, which, when it exceeds 8% in any tankage, renders its assimilation by the soil extremely difficult.

To really complete the cycle of operation, the dried sludge should be percolated, grease removed and the percolated tankage redried. Since, however, a large percentage of the grease present is in combination with alkaline earth and metals in the form of metallic soaps, it renders solution by simple percolation impossible. For this reason it is necessary to acidulate the sludge, prior to percolation, with some mineral acid, so that the fatty acids combined with metals as soaps will be liberated and put in such condition that they will be soluble in the usual solvents employed in percolation.

This acidulation would have to take place prior to the drying operation, in suitable lead-lined digesting apparatus, and no matter how carefully this operation were carried out, the wear and tear on the drying apparatus and the percolator, due to acid action, would render the operation very expensive and troublesome. Not only would the apparatus employed be very short-lived, but the action taking place between the liberated fatty acids and the grease in immediate contact with even a trace of mineral acid at high temperature, would crack the fatty materials so badly as to render them valueless.

This was very evident in attempts by the writer to handle samples of sludge made by the acid, or Miles, process, by direct drying. At a certain point where most of the moisture was eliminated, charring took place, with copious evolution of sulphur dioxide and acrolein vapors, and the grease obtained by subsequent extraction and distillation gave an extraordinary amount of tar and unsaponifiable matter.

Percolation and Redrying Unsuccessful

Not only does this reaction take place in the drying operation, but the solvent carrying the grease also carries with it small traces of mineral acid which must be carefully washed and settled out before distillation for recovery of solvent. If this is not done upon approaching a certain concentration in the still, violent foaming, with evolution of sulphur dioxide and fatty decomposition products, takes place and again the grease is damaged. It may be well to note that the mineral acid referred to is, of course, sulphuric acid, no other acid being available, on account of price, for use on such low-grade raw material.

For the above reasons, the operation of drying, percolating, redrying, etc., so readily applied to other materials, seems not to be very successful when used on sewage sludge.

Destructive distillation of the dried or semi-dried sludge has been attempted, with the usual methods of recovery of the ammoniacal liquors and oils. Here again the problem of moisture elimination is intruded, and the recoveries made are not such as warrant the hope of even paying for the operation, much less of showing any profitable return. In the case of distillation both of dried sludge and of garbage tankage, the experiments of the writer have in all cases failed to show a greater recovery of nitrogen in the ammoniacal liquors than 35 to 40% of that present in the original samples. As a rule, an additional 30% remains in the retort charcoal, with the residue passing off as nitrogen in the combustible gases. The oils passing over are of little value except as fuel. This appeals to the writer as being a very expensive way of producing fuel oil.

Acidulation of semi-dried sludge from filter-presses or centrifuges, followed by drying in retorts, with subsequent distillation in current of superheated steam to carry over the fatty acids liberated by acid, has been tried but found unsatisfactory for many reasons.

Methods have been described and tested out on a large scale, attempting the direct extraction of greases from wet sludge by volatile solvents. In these processes, which are difficult and expensive to carry out, a partial solution of the free grease results, together with a portion of the waxes and soaps existent in sewage. The result is the formation of extremely resistant emulsions which seem to defy any recovery treatment by distillation. After such an emulsified mass has reached a certain concentration in the solvent

recovery stills, the whole charge expands into a foamy mass of which, seemingly, a gallon will fill a large tank.

An endless number of methods and schemes have been tried, first and last, but apparently none had sufficient merit to survive the first attempts. Possibly many failed under market conditions which do not exist at the present time; or, what is more likely, at their beginning they promised so much that mere partial success gave nothing but discouragement.

Leaving the recovery method aside for the moment, are there any—and if so what are—the inherent values of sewage sludge? What type and condition of the sludge offers the greatest possibilities?

Grease and Nitrogen Content

Setting aside for the present the moisture content, the value of the sludge will be governed by its grease and nitrogen content. While all sludges contain small percentages of bone phosphate and potash, from a practical standpoint they may be neglected. Consider the following analyses (dry basis):—

	Ammonia	Grease
Baltimore sludge, acid process, fresh, ..	3.26%	27.23%
Boston sludge, acid process, fresh, ...	3.91%	29.30%
Chicago Sanitary District, activated sludge, fresh, ...	5.10%	14.70%
Pleasantville, N.Y., settling basins' sludge, one month in basins, ...	4.14%	27.40%
Syracuse settling basin's sludge, fresh, ..	4.02%	9.60%
Syracuse activated sludge, fresh, ...	5.06%	17.70%

All of those analyses are from samples of sludge produced from comparatively fresh sewage and are representative of sludge rapidly deposited and not allowed to rest in the tanks for any great length of time. For that reason little bacterial action had taken place and the ammonia and grease content are at their maximum for the different types of sludge. Compare with those, these analyses of samples of sludge from so-called septic tanks or sludge which has been exposed for a great length of time on drying beds:—

	Ammonia	Grease
Baltimore sludge (from tanks) on bed approximately 6 months, ...	2.34%	1.50%
Chicago, activated sludge, 9 months old, ...	4.40%	5.00%
Akron, O., sludge, 3 months in tank, 6 months on bed, ...	1.00%	6.00%

All other things being equal, the value of a sludge for by-product recovery purposes depends upon the shortest possible period of tanking and shortest elapsed time between tank and ultimate utilization. In other words, bacterial action and weather erosion must be restricted to a minimum. This is directly contrary to usual sewage practice and is one of the rocks on which the disposal proposition has stumbled.

Minimum Value Worth Recovering

Below a certain minimum of recoverable values, there is no use attempting recovery. This minimum seems to be, for low-grade ammoniates such as garbage tankage and sewage sludge, approximately 3% ammonia. Below this the expense of handling and freight cost put it out of all hope of competition with other and more concentrated materials. From an economic and business standpoint, any goods falling below this rating had better be forgotten and no time wasted on developing methods of handling.

Moisture content of sludge leaving tanks is the next most vital consideration. In order to come within economic range of any method of artificial drying of any material containing 3 to 3.3% ammonia and 10 to 15% grease on dry basis, moisture must not exceed 75 to 80%. All sludges as they come from tanks or basins are far above this, and activated sludge way beyond. Sludge from ordinary sedimentation basins can be drained and air-dried within several weeks to 77 to 80% moisture, and by centrifuging to about the same amount. It would appear, however, that the simplest and most inexpensive method is that of depositing sludge, after removal from tanks, on drainage beds exposed to atmospheric drying conditions. In any case, without the presence of water dumping facilities, the sludge must be partially dewatered before final disposition.

With sludge containing 75% moisture, the ultimate disposition with by-product recovery is not impossible, though difficult and presenting many curious conditions.

To accomplish the disposal with production of a marketable tankage and grease, the elimination of all of the moisture with subsequent extraction of the grease by volatile solvents, a system of drying, extraction and recovery in one operation is suggested. Such a combined and complete operation is carried out at the present time only by the Cobwell process.

This process, as is doubtless well known, is applied to the handling of municipal garbage, dead animals, slaughterhouse offal and other wet organic waste materials. At the request of several engineers and municipal officials, a number of small-scale and several large-scale experiments have been undertaken and carried out on sewage sludge, with results which seem to warrant some hope of solution of the problem.

Adaptation of Cobwell Process

It is unnecessary to go into any detail in description of a process with which most engineers are familiar. But some variations are required in applying it to handling of sewage sludge.

In this method of dehydration with simultaneous degreasing, the principle employed is that of desiccation in a hot bath of an immiscible solvent which shall serve not only as a dehydrating medium but shall also, during the period of drying, continually dissolve the grease contained in the material to be dried.

Such a solvent preferably employed in the handling of sewage sludge, is a high boiling petroleum naphtha, distilling within the range 360 to 420 degs. F., which corresponds to the first 60 to 70% over in the fractionation of "standard waterwhite kerosene." This material serves not only as the most economical heating medium, but owing to the high temperature maintained in the desiccating mass, serves to remove or dissolve the metallic soaps as well as the free grease.

Cold, or merely warm, solvents of a less oily nature have little solvent action on such soaps, but high boiling oils, particularly when carrying small quantities of grease, are able to dissolve them without difficulty. Upon cooling they are apt to be deposited as jelly-like masses or to cause the gelatinization of the whole solvent solution, and for that reason the solution must be treated, before entering recovery stills, in such a manner that the soaps are decomposed and a solution of clean fatty acids result. This treatment will be taken up in order.

Description of Apparatus

The following is a brief description of apparatus and the method of carrying out the operation:—

The principal apparatus consists essentially of a closed tank, circular in shape and of a diameter three times the height. Jackets are provided on the bottom and well up the sides, so that as much available heating surface is obtained as is possible. Through the bottom, oblong screened openings are provided for the withdrawal of solvent and grease, and for the pumping in of solvent during the cooking or desiccating operation.

Within the tank proper is a central shaft, provided with two sweeps set very close to the bottom in such a manner that they shall slide under the mass to be treated, imparting an undulatory motion, without cutting through the mass itself. For this reason very little power is required. The tanks are of shallow form in order that the amount of heating surface in proportion to the mass to be treated may be as great as possible. Greater height and capacity could only be obtained at the expense of operating time and greater consumption of power. The top of the tank is provided with charging manhole and outlet pipe to condenser for vapors.

After the tank is loaded with sludge, the charging manhole is securely closed by the swing cover, solvent is admitted through the bottom screens, sufficient to immerse totally the mass of sludge, and steam turned on jackets.

Combined vapors of solvent and water vapor pass out through vapor line to surface condensers of suitable capacity, and in these the mixture of solvent and water vapor is condensed to liquid, which, leaving the tail pipe of the condenser, passes to separating tank, where by virtue of the lighter gravity of the solvent, separation of solvent and water is effected. The solvent flows to storage for re-use. Owing to rapid evaporation, the solvent level is lowered in the tank and a further quantity is pumped in.

Four to five hours are required for the evaporation of all of the water, and at this time, through the sight glasses, the dried fibre, etc., can be observed floating on the top of the solvent. At this point the agitator is stopped, the steam turned off, the drain valves opened, and the grease-laden solvent pumped out through a solvent out-pump line. Several washes with fresh solvent complete the degreasing of the mass, which is then heated, agitated and (with the help of live steam) freed from the absorbed solvent left in the mass after draining.

Preliminary Treatment

Solvent carrying with it the extracted grease, soaps, etc., must receive preliminary treatment before passing to the solvent-recovery and grease-finishing stills. This treatment is carried out in a lead-lined tank provided with an agitator. To the solvent is added a sufficient quantity of sulphuric or muriatic acid and water to completely decompose the metallic soaps present. The acid water is well churned up with the solvent, allowed to settle and drained off; fresh water is added and mixed, allowed to settle and the clear grease-solvent solution run to the recovery stills.

By this treatment, foaming and other difficulties are avoided in the distillation, and the grease recovered does not form the difficultly separated emulsions it is disposed to do. Such grease can be cleaned up and settled free from mechanical impurities and moisture without undue trouble.

The entire cycle of operations takes place in a closed circuit, and the only vent for non-condensable gases for the whole system of tanks (or reducers), condensers, separating tanks, washers, stills and storage tanks, is on the final solvent storage tank or tanks. This vent in turn exhausts through an oil scrubber to recover traces of naphtha carried over by carburetting. During no period of the operation is the sludge exposed to the air or manhandled in any way, until it is finally discharged from the side-door of the tank in a dried, degreased condition. The only places where odors or noxious effluent is exposed to the air and liable to cause an unsanitary and nuisance condition, are at the gas vents on the storage tanks and at the effluent overflow on the separating tank.

This effluent is, of course, distilled water from the sludge, and carries with it the odor of the sludge, which in the case of fresh sludge and that preferably handled, is very offensive. The quantity of this water is of course equal to that contained in the sludge prior to desiccation and the condensed steam from the steaming out of the solvent from the drained sludge prior to dumping from machine. This approximates a ton of effluent for every ton of sludge handled.

Deodorizing Effluent by Chlorination

The only way found by the writer to effect deodorization of this effluent and to render it harmless is by the addition of chlorinated lime or chlorine water. The greatest amount necessary for deodorizing very foul water is one part of 35% available chlorine bleaching powder to 3,000 parts effluent. The non-condensable gases leaving the storage tank vents must be scrubbed with chlorinated lime solution before being allowed to pass to atmosphere.

With these precautions, it is safe to say that the entire operation of desiccation and degreasing, or the whole recovery operation, can be carried out with no offense to public welfare and sanitation.

In handling sewage sludge by this method, no difficulties have arisen, other than those usually met with in handling wet organic materials of other sorts, and since in sludge the moisture is present in free condition, mechanically combined, the period required for desiccation is much shorter than that met with in the treatment of garbage and animal refuse, in which the majority of the water is more or less chemically combined. For this reason only four or five hours are required in drying a given amount of sludge, compared with at least twice that for same amount of garbage.

Capacity and Cost

Experiments and trial runs indicate the capacity of each tank as 8 tons in 24 hrs., and in a plant handling the sludge from a town of 200,000 inhabitants (approximately 40 tons daily, 75% moisture basis) the cost for handling, including overhead and fixed charges, will approach $6 to $6.50 per ton on green sludge.

This cost will not be greatly changed in handling sludge containing 65% or 50% moisture, but since the gross tonnage to be handled would be greatly reduced, the plant investment would be greatly reduced, and the by-product returns per green ton much greater. If by any method of dewatering on beds or other inexpensive method, the moisture can be reduced below 75%, by just so much will the success of a recovery plant pass from just self-maintenance to a possible profit.

After carrying out such an operation, what possible yield of by-products may be expected, and what is their character and what their value? This depends entirely on the nature of the sewage handled. It has been presupposed that any sludge running less than 3% of ammonia on a dry tankage basis is not worth handling, unless indeed the grease content is very high, in which case it is possible that the grease alone might pay for recovery.

From an average of a number of analyses, however, it would seem as if a sludge low in ammonia is also low in grease, so that a 3% ammonia tankage would indicate a 15 to 25% grease content on a dry basis. For these reasons, in handling a 75% moisture sludge, a yield of 420 lbs. of tankage and 75 lbs. of grease may be expected.

Market "Value" of Grease

What is the nature of this grease and tankage? Have they any market value? What use is it to rescue this material if it cannot be sold or used? This is not a matter to be dismissed offhand. At the present time, if either or both of these products were thrown on the market, emphatically they would not find a purchaser, or certainly the price would be absurdly low. Consider the nature of these by-products as indicated by their analyses:—

Analyses of Greases From Different Types of Sludge

	Free fatty acid.	Unsaponifiable.	Neutral.	Dirt and moisture.
Baltimore (acidulated),	77.48%	11.78%	.....	10.74%
Chicago (activated), ..	48.80%	24.40%	19.10%	7.70%
Syracuse (sedimentation),	51.50%	19.30%	18.70%	10.50%
Pleasantville, N.Y. (sedimentation), ...	75.70%	19.80%	4.50%	.....

Boston, Moon island (sedimentation):—

Free fatty acid (as oleic), ...	48.40%
Free fatty acid (by weight), ...	40.19%
Rosin acids (in fatty acid), ...	14.36%
Fatty acids (by difference), ...	25.83%
Unsaponifiable, ...	21.09%
Neutral grease (by weight), (molecular weight of neutral fatty acids, 272), ...	20.00%
Metallic soaps and solid impurities, ...	3.30%

The first four analyses are of grease recovered in the process outlined, and it will be noticed that in the first three, large quantities of solid impurities and moisture are recorded. All grease of sewage sludge origin on leaving stills contains large amounts of such impurities, since due to the emulsifying action of the waxes present in the so-called unsaponifiable, it is very difficult to obtain clean greases without subsequent washing with acid and settling. The fourth analysis is of a grease after such treatment.

These analyses are of several different types of sludge and sewage treatment, yet all present the following general characteristics:—

The saponifiable matter in each case consists for the most part of free fatty acids and a very small portion of neutral grease or combined glycerines. This is, of course, anticipated by the fact that the greater part of the grease present in sewage sludge comes from hydrolyzed soap solutions, or through the action of bacteria and ferments, neutral grease has been broken down into fatty acids and glycerine. In any event, the neutral grease present gives no hope of glycerine recovery, so at once the so-called grease falls into the grade of poor-class fatty acid stock. Of the total fatty acids present in a number of analyses, from 1 to 15% of the total consist of rosin acids. These again are from the soap solutions.

The unsaponifiable matter varies from 10 to 30%, but a majority of samples analysed show an average of 20%. As may be supposed, the lowest percentages are found in strictly domestic sewages, where they are traceable to body waxes and products of physiological action. In mixed sewage from manufacturing towns, the unsaponifiable is highest, as it is made up of mineral oils thrown out from different factories, wells, etc.

A small percentage of metallic soaps of calcium, iron, aluminum and magnesium are present, but upon proper treatment are broken down into fatty acids and mineral salts, washed out as sulphates or chlorides (depending upon the sort of acid used for refining).

Very Low-Grade Material

From these premises it is necessary to conclude that sewage grease can be regarded only as a very low-grade fatty acid stock containing 70 to 75% of fatty acids and 25 to 30% of unsaponifiable. These fatty acids, depending on the sewage from which they are extracted, will vary in color from a dark ruby red to a black, tarry-looking mass. In consistency the variation is between a soft, buttery mass and a hard, solid cake. This is quite readily explained; the former is very high in fluid mineral and industrial refuse oils, the latter from domestic sewage in which the high-melting-point fatty acids have been hydrolyzed and precipitated from the soap liquors, whereas the oleic-acid soaps or oleic acid present in mixed soaps, remain in solution and pass off with the effluent.

Fatty acids of this type have no legitimate market at this time. Such materials are only valuable as they are refined and made into marketable products. A purchaser of sewage grease would have to expect by his own efforts to give it all of the value it might ultimately have, and having created something out of nothing, he would care to pay little for the raw material. That sewage grease in refined or manufactured form has value is not to be questioned. Such a grease as that indicated by the analyses of Pleasantville sludge grease, upon distillation in the manner usually employed for fatty acids, gave the following yields:—

Light colored distillate,	85%
Still returns,	6%
Stearine pitch,	6%
Loss,	3%

The distillate was orange yellow in color and of high titre, and upon pressing gave 50% of good colored stearic acid of titre 53.3C., and 50% of red oil containing 38.25% unsaponifiable. Upon pressing, all unsaponifiable matter passes out of seeded or crystalline cake in the red oil, leaving good stearic acid behind. This red oil is marketable for grease-compounding and as wool oil. In other words, sewage grease must be manufactured to have value. Once its value is established, a market will be automatically created for the raw grease.

Shall Municipalities Combine Efforts?

Upon whom shall the burden of carrying out these operations fall? Shall each sewage plant carry out the whole work from sewage to finished product? Shall a number of sewage plants pool their sludge, or their raw grease and tankage, and finish at a central plant, or shall a number of plants interest directly a corporation or individual able to carry out the refining operation? At this point sewage sludge ceases to be a problem for the scientist and becomes a purely business proposition.

Returning to the question of disposition of the tankage, it would require considerable propaganda to place upon the fertilizer-goods market a low-grade 3% ammoniate, cursed with the name sewage sludge, though in the old days of poudrette it had an enhanced value in the public mind far greater than its chemical value indicated. The great diluent of sewage tankage is insoluble ash or mineral matter, running from 40 to 70%, with 60% as an average. It is not impossible to concentrate this, though methods are not yet complete for doing so. A number of experiments conducted by the University of California indicate that for percentage of nitrogen contained, degreased sludge has higher plant-food value than that in dried blood or high-grade tankage.

Even with reasonable markets for the tankage and grease, it is a question whether it is possible to recover enough materials to defray the cost of the operation. In the opinion of the writer, and from experience in the garbage-reduction business, it does not seem impossible, though there would be little margin of profit left. But the sludge would be disposed of, its disposition paid for and a large amount of needed materials returned to active use, assisting in helping out the world's supply of chemicals and greases. The individual city would receive no monetary return, probably, but virtually to create actual concrete products of economic value, to pay for the creation and at the same time solve a troublesome disposition problem, is something well worthy of consideration.

With ordinary sedimentation of suspended solids, it is not at all unreasonable to expect from the sewage of a town of 150,000 people, daily recoveries of 5 tons of tankage and 1 ton of grease. There are many towns of this size. Any city of this class which can return to a useful cycle $50,000 worth of needed materials annually should consider well the disposition of its sludge pile.

Solving the problem of sludge disposition is not impossible, but it is difficult. No chemist, engineer, business man or politician can solve it alone. That co-operation which has not existed must first be accomplished before there may be any hope of solution.

Approximately 100 miles of road have been resurfaced this year in Elgin County, Ont., and eight culverts and two bridges have been built. The total expenditure on construction, maintenance and overhead has amounted to about $140,000.

Four by-laws have been passed in Calgary, voting $350,000 for a sewage disposal plant; $278,316 for extensions to the waterworks system; $155,978 to be added to a sum previously voted for building a concrete bridge to replace the Louis bridge over the Bow river; and $155,000 for a fireproof addition to the hospital.

Hon. Peter J. Veniot, minister of public works in the New Brunswick government, speaking at St. John, N.B., stated that New Brupnswick, of all provinces in Canada, is the only one that constructs and maintains its roads entirely from provincial funds. In the past three years, the sum of $2,125,000 has been spent on public roads, and it is hoped that during the next ten or fifteen years it will be possible to repair and maintain in good condition all the 17,000 miles of main trunk roads in the province.

With the intention of supplying Halifax with 7,800 h.p. at an estimated cost of $1,200,000, the Nova Scotia Power Commission has been authorized to proceed with the development of the water powers at St. Margaret's bay. The preliminary plans call for the establishment of storage dams at various points on the Northeast and Indian rivers. The water of the Northeast river will be collected by a head dam at Coon pond, and thence directed by a flume to a power-house at the head of Mill lake, where a head of 160 ft. will be obtained. The water of the Indian river, collected at a head dam at the foot of Sandy lake, will be directed to the same power-house, giving a head of 100 ft. A third flume will conduct the water from this power-house to a second power-house, which is to be established at tidewater, where the head is 90 ft. The power will be transmitted to Halifax on a wooden pole transmission line, 20 miles long.

ESSEX BORDER WATER WORKS

DESIRING to consolidate the existing water systems within the district, the Essex Border Utilities Commission has adopted a report which has been presented by Morris Knowles, Ltd., consulting engineers, Windsor, Ont., and will soon ask the people of the Border Cities to vote upon the scheme.

In the engineers' report, provision is made for five years' development of the water supply systems of the border municipalities, whereby the present generally unsatisfactory conditions of supply in the district will be relieved, and new territory which is not now supplied with water will be made available.

An approximate valuation of the Windsor water works, the Walkerville Water Co.'s distribution system and existing pipe lines in Ford City, Sandwich, Sandwich East and Sandwich West, totals $950,000, and an approximate fair compensation to Hiram Walker's Sons, Ltd., for pumping equipment is estimated by the engineers at $30,000. It is recommended that these systems be consolidated under the commission's direction by assuming the indebtedness now carried by the various systems and by issuing debentures to the various corporations for the remaining value.

The first year's program of improvement to the existing system includes the extension of a pipe line from Windsor to and through Sandwich to form a complete loop, at a cost of $95,000, and the arrangement of a site for consolidated supply and purification works, at a cost of $200,000.

During the second year it is proposed to start the construction of the consolidated works and filter plant, at an estimated expenditure of $250,000, and to connect with the Windsor distribution system by means of a 36-in. main, at a cost of $185,000. This would give a much better distribution system, and as soon as the pumps are ready to operate, would provide, by means of the extensions recommended for the first year, a much improved domestic and fire service for Ford City, Walkerville, Windsor and Sandwich.

Further extension of the distribution system in Windsor and Walkerville is contemplated for the third year, and is estimated to cost $105,000. The construction of the pumping station and filter plant would also be completed at a further cost of $225,000.

For the purpose of reinforcing the distribution system in Windsor, and giving much needed fire protection in the business area, several 12-in. mains would be laid during the fourth and fifth years. The distribution system would be extended from Sandwich to Sandwich West and Ojibway, further reinforcing mains in Sandwich bringing the total expenditure for these years to $220,000, and making a grand total, for the five-years' development, of $1,130,000.

By acquiring the Windsor pumping station and taking over the pumping equipment of Hiram Walker's Sons, Ltd., it would be possible to utilize in the consolidated pumping station the pumps which have been recently purchased by the Windsor Water Commission and also the newer steam pupms in both the Windsor and Hiram Walker stations.

The Bureau of Municipal Research has issued a bulletin on "Forms of City Government," which says:—"To overcome some of the drawbacks of the mayor-council-board-of-control plan, the formation of an administrative board, made up of the heads of the various civic departments, with one of their number as chairman, has been suggested. This could be tried by any city, without change from the present system, simply by directing the heads of departments to meet once a week for discussion of administrative policies and the taking of joint action wherever possible without special legislative enactment. A mayor, council and board of control could be elected on the plan at present in use, council retaining its legislative and policy-deciding functions. Later, if the working of the board was successful, provisional legislation could be obtained to enable it to undertake the work now done by the board of control. The city council could then keep in touch with the departmental administration through a small executive committee appointed from their number to act with the administrative board."

REGULATIONS UNDER CANADA HIGHWAYS ACT

Order-in-Council States Method of Making Application for Federal Aid and Gives Information Regarding the Proposed Administration of the Act

SECTION five of the Canada Highways Act, which was passed last July by the Dominion parliament and which will be administered by A. W. Campbell, commissioner of highways, states that the governor in council may make such regulations as are deemed advisable for giving effect to the objects and purposes of the Act, which appropriates $20,000,000 to encourage the provinces in the construction or improvement of highways. In the December 13th issue of the "Canada Gazette," the official medium for notices of government rulings, notice is given of the adoption by order-in-council of the following regulations under the above-mentioned Act:—

"Sec. 5—The governor in council may make such regulations to be published in the 'Canada Gazette' as are deemed advisable for giving effect to the objects and purposes of this Act."

Work to be Aided

1. The highways to be aided under the Act shall comprise such main and market roads as have been designated by the province as hereinafter provided with a view to encouraging production and stimulating trade and commerce, and as shall be approved by the minster.

To Supplement Customary Expenditure

2. It is understood that the expenditures called for under the Canada Highways Act are intended to supplement the usual amounts granted and devoted to the construction and improvement of its highways by the province itself.

Method of Making Application

3. Before an agreement is made with respect to any road or roads, there shall be furnished to the minister by the provincial government a statement setting forth a programme for construction or improvement of a system of highways in the province, from which projects shall be selected. Such statement shall be accompanied by a general map of the proposed program, bearing the approval of the provincial government and the endorsement of the highways department thereof. Each provincial program shall include, first, roads having greatest local agricultural and commerical importance; and second, roads having both local and general importance, and these programmes shall be so adjusted and arranged that the whole shall be correlated and form, as far as possible, a general system of interprovincial highways. This program and amendments thereto shall be satisfactory to the minister, and applications relating to the construction of specific portions thereof shall be made from time to time as provided for in the following section:—

Plans, Specifications, Estimates, etc.

4. Each application for aid shall be embodied in a project statement, on forms which may be had on application to the commissioner of highways of the department of railways and canals, which shall contain the following information and exhibits:—

(*a*) The purposes the undertaking will serve, and why it is in the public interest;

(*b*) The character and extent of traffic, present and prospective, on the road;

(*c*) How the undertaking relates to the provincial program;

(*d*) A statement of the type of construction or improvement it is proposed to make, together with a report of the engineer of the provincial highways department endorsing the adoption of the proposed type and the design thereof as being the most economical and practicable in the public interest, his reasons therefor, and a full explanation of any special or unusual features thereof;

(*e*) The administrative control of and responsibility for the undertaking;

(*f*) The source and method of procuring the necessary money for the underaking and the extent to which interested municipalities contribute thereto;

(*g*) Plans in standard form to be prescribed by the minister and in detail following accepted engineering practice, together with a sketch map showing the position of the proposed project on the general program map of the province;

(*h*) Specifications in standard form to be prescribed by the minister setting forth the proposed type and method of construction, materials to be used, and other essentials, in such detail as to afford complete knowledge of all steps to be taken in carrying out the project;

(*i*) Copies of the form of contract to be used, together with all documents referred to therein or made a part thereof; and

(*j*) Estimated cost of the project, giving a schedule of quantities and the estimated cost of each item in detail.

All project statements, plans, specifications, estimates and other papers required in connection with any application of a province for aid under the Act shall be forwarded to the commissioner.

The Agreement

5. When a project statement has been approved by the minister an agreement, as provided for in the Act, between the province and the minister shall be executed in triplicate by the province on a form furnished by the commissioner.

No payment under the Act shall be made until such agreement has been executed by the minister, nor shall payment be made for work done prior to such execution unless with the express approval of the governor in council, which approval shall not be given in connection with work done prior to the coming into force of the Canada Highways Act or not done in accordance with these regulations.

Tenders and Contracts

6. All expenditures shall be made pursuant to tender and contract, except as provided by the Act, and shall be on the basis of unit prices. Tenders shall be called for at least three weeks before the work is to be let, and notice of the calling for tenders shall appear in a contractors' or engineering journal as well as in such local newspapers as the province deems necessary.

Payments

7. In determining the actual necessary and reasonable cost of any highway for the purpose of fixing the amount to be paid under the Act, the cost of the following shall not be considered as a part thereof:—

The cost of right-of-way and incidental damages, bridges, viaducts, subways, exceptional grade separation, provincial overhead and administrative expenses, the making of surveys, plans, specifications and estimates, or any engineering expenses incident to the project prior to the beginning of actual construction. The cost of culverts having a clear width of opening of not more than twenty feet may be included.

Certified vouchers showing the amounts expended on each section of completed road, also showing the amount, if any, expended on any uncompleted section up to sub-grade at the termination of each fiscal year during the five-year period commencing April 1st, 1919, shall be submitted to the commissioner; and when he has certified that the terms and conditions of the agreement, in respect of the plans and specifications annexed thereto have been carried out as far as relates to such sections, forty per cent. of the cost thereof as defined by these regulations, and expressly subject to section five thereof, will, upon authority of the minister, be paid to the provincial treasurer, or other person named in the agreement to receive the same.

Records

8. Such records of the tenders submitted of the cost of the work, of the inspections made and tests of materials shall be kept by the province as shall enable the commissioner at any time to determine the cost to the province and the status of the construction work done on any project. These accounts and records, together with all supporting documents, shall be open at all times to the inspection of the commissioner or his representative, and certified copies thereof shall be furnished at his request.

Inspection

9. The supervision of each project by the provincial highway department shall include adequate inspection of work and material by competent engineers throughout the course of construction. To this end, any recommendation of the minister to the provincial government with respect to the necessary technical qualifications and experience of the members of the highway organization will be enforced by such government.

Maintenance

10. Each province shall agree that when the roads or highways constructed or improved with Federal aid shall have been accepted as completed, the province shall maintain, or cause the same to be maintained, with all necessary repairs and renewals, so as to preserve the standard of construction of each particular class of completed road or highway.

CONFERENCE ON CONCRETE HOUSES

FROM February 17th to 19th there will be held at the Auditorium Hotel, Chicago, a National Conference on Concrete House Construction. The purpose of the conference is two-fold: (1) To consider the housing problem in the United States and Canada; and (2) to present, crystallize and make available, information regarding the most modern practice in the construction of concrete houses.

The following committees are now being organized: Architecture and design, community planning, financing permanent homes, fire prevention and insurance rates, building codes, monolithic concrete houses, special unit houses, concrete block houses and concrete and cement roofing.

Among the organizations co-operating in this conference are the American Concrete Institute, the Associated General Contractors of America, the Concrete Products Association, the Portland Cement Association, the Illinois Society of Architects, the Illinois Chapter of the American Institute of Architects, and the U.S. League of Building and Loan Associations.

During the week of the conference on house construction, there will also meet at the Auditorium Hotel the American Concrete Institute, the Concrete Products Association, the Concrete Block Machinery Association and the American Concrete Pipe Association.

Work has been completed on the installation of the hydro-electric power plant at Squamish, B.C., the tidewater terminus of the Pacific Great Eastern Railway, and the plant will be "turned over" this month. The project involved the construction of a dam in the Stuwamus river. The cost of the development was about $90,000.

Premier Drury, of Ontario, outlining the road policy of his administration, said that it is the people of the little towns and rural districts who need good roads the most, and that there is great need for market roads throughout the province. It had been argued, he said, that the revenue from motor cars should be expended on main highways. He held that part, at least, of this revenue should be used on roads serving the greater body of people. His highway policy would include these three things, he said: (1) The abandonment of the construction of expensive trunk highways, retaining the roads already built and probably improving them and making them all into "decent-running roads;" (2) spreading out the provincial roads where they will do the "greatest good to the greatest number," spending the money available on the whole road system and giving aid to country roads; and (3) giving assistance to township roads.

WHY QUEBEC MUNICIPALITIES SHOULD HAVE CLEARING HOUSE FOR INFORMATION*

By Charles A. Mullen
Director of Paving Dept., Milton Hersey Co., Montreal

THE broad objects of the Union of Quebec Municipalities, briefly stated, are to secure voluntary co-operation among the member cities, for the support and collective municipal ownership of a public organization to act as a clearing house for information and as a central bureau through which two or more cities, when they so desire, can combine for the purpose of securing from the province legislation which in is their interest, and for any other matter wherein it is thought two or more cities, acting together, can get better results than if they acted separately.

A service that could be organized quickly, and which would at once begin to pay dividends in savings effected by the several municipalities, is a central bureau which could be used for purchasing many items of supplies. This service would not abolish any separate municipal purchasing bureaus now in existence, but would be rather a super-bureau, requiring a well-organized system of purchases in each member city, for its proper working.

Central Purchasing Bureau

Why have the purchasing officials of many cities getting data and prices on general equipment they all use, when it can all be done by one man; and why not buy collectively whenever it is possible to do better that way? The organization of proper purchasing systems for its member cities would in itself be a suitable field of activity for this Union, and one good man, who would by study and experience become particularly proficient, could be handed around from city to city.

Through a central organization, each municipality will be better able to look its latest "gift horse" in the mouth, for the collective transactions of all the cities in any one article which is offered in the municipal market will be of sufficient moment to warrant the spending of a little money on investigation and study.

In no line, I think, is this more true than in my own; for were a careful engineering report secured by such a Union as this upon certain pavements which are being laid, and copies submitted to the various member cities, I think that pavement promoters would grow less fat and municipalities go less into debt and occasionally into a state which approaches bankruptcy.

Such a bureau, be it purchasing or any other, should have as its board of directors the purchasing or other interested officials of its member cities, and the super-purchasing agent should be their employee,—not their boss. Much greater efficiency, in many cases, comes from the bottom up, and I am inclined to think that the success of the Union of Quebec Municipalities is largely going to depend upon whether or not those entrusted wits its launching will properly understand this principle and use their best energies in setting it to work. These are not days to talk of abandoning the principle of Home Rule for cities, even for the purpose of forming a municipal union. One ounce of voluntary effort is worth a pound of forced co-operation.

"Engineering Profession Principally Involved"

One great value the Union will have for its member municipalities will be in supplying them with reliable information and advice when they have to deal with professionals, especially from out of town; and here the engineering profession, of which I am a member, is principally involved, though the lawyers and the doctors also come in for their share of municipal work.

It may be true that when the Union attempts to handle engineering matters for the member cities, if great care is not exercised, there will be a slight danger of injustice to some of the profession; but I do not think this danger is to be compared to that which the cities encounter when they go out, unaided, to seek engineering or other professional advice and services. High-class engineers are frequently not nearly so good at selling their wares as some other engineers who would do the country much less harm as commercial travellers.

There are, as we all well know, shysters in all the trades and professions to-day, for our present social system seems to encourage and reward their efforts in many directions. Under the plan of co-operative administration I have already outlined, where the engineering bureau would be in the hands of the engineers—subject, of course, to the general administration—it seems to me that the shyster would have a much less rosy path than he has to-day.

Says "Canadian Engineer" Mistaken

The Canadian Engineer of October 23rd, in its editorial column, shows grave concern about what it thinks the Quebec municipalities are about to do; but I am sure its attitude is based on a misconception of the plan. To me, it seems that more and not less professional services will be employed because of the existence of this Union. Cities will learn from their own representatives at headquarters, whom they will have reason to trust, just when and to what extent professional services are a good investment for them. To-day, they do not know, and have not a sufficiently unbiased and trustworthy source of information; and they frequently go without rather than risk employing some shyster.

I am quite sure that it was also a misunderstanding which led *The Canadian Engineer* to remark about the doubtful value of "free" engineering or other professional services. The Union will be paid by its supporting member municipalities through memberships, as far as its general work is concerned; and each city will probably pay extra for special services rendered. We have never heard the engineers complain when several private corporations formed a union or trust and amalgamated their engineering staffs, and such combinations are far more destructive of individual initiative and competition among engineers than the Union of Quebec Municipalities could ever hope to be.

Impugns One Firm's Integrity

One good which the engineering profession should get out of the formation of this Union is the better application of the energies of its members.

I have one particular case in mind where a firm of engineers undertook a piece of work in which they certainly were not specialists. The contract was let; and, not having an intimate knowledge of the subject, these engineers left it to the contractor to do the work in accordance with his own theories, which happened not only to be based on a limited experience and wrong, but were known by all specialists in that line to be wrong. The work, after one year, now shows signs of failure. It is bad enough to have to follow defective principles when it is not possible to follow the correct ones; it is inexcusable to do so through ignorance of those principles which have been proven correct in practice, and are generally accepted among the specialists in that field of engineering.

The leading member of the engineering firm referred to above, whose name professional courtesy prevents me from mentioning, at the time this work was being done in accordance with wrong practice (because to insure correct practice they would either have had to call in specialists and pay them out of their own very liberal fee or not attempt the work) said to me:—

"We never take a chance. If we are building a wall, we figure the usual factor of safety required by good engineering practice, and then add at least 20%. Our work is a monument to us, and our reputation is the very highest."

Yes,—building monuments to the reputation of their firm by the unjustified expenditure of public money, which expenditure also increased their percentage fee. The cities are, to-day, almost helpless before such engineering malpractice; in fact, on the part of unscrupulous engineers, it is an excellent way to acquire a very fine appearing though falsified reputation which will bring more business. The point in this instance is that this firm was willing to take all sorts

*Excerpta from paper read at the organization meeting of the Union of Quebec Municipalities, at Montreal, Que., December 16th, 1919.

of chances with their reputation to save themselves a few extra dollars, but was perfectly willing to buy the best reputation at any cost whatever with city money. One good engineer on the bureau staff, keeping in touch with the field, would soon detect and expose such malpractices as these.

Many cities are to-day repating the mistakes made by other cities, and thereby learning through their own costly experience what they might much more cheaply know from the dearly bought experience of other municipalities. I have in mind one city in particular which is now going ahead with a certain type of paving work which was tried out and abandoned in other places many years ago. It thinks it has discovered something new.

Suggests Visiting Engineering Specialists

What we need is a clearing house for knowledge and experience, where a city may inquire about what has been done elsewhere and what were the results. The Union of Quebec Municipalities promises to furnish such a clearing house for this province, and I believe the results will be most gratifying. A step still further would be advisable; and it may be practical at some future date to have a staff of visiting engineering specialists go around and see what the cities are doing in the way of following wrong practices without even suspecting it themselves.

Another service that may be facilitated by the union is the exchange of expert operators between the different cities. This fall, the city of Charlottetown, Prince Edward Island, which has installed a municipal asphalt plant, needed some expert laborers for operation. We appealed to Mr. Doucet, the director of public works, and to Mr. Blanchard, his engineer of roads, of the city of Montreal, and they were glad to go out of their way to accommodate a small city in a sister province. Montreal men went to Charlottetown, and did their work so well that Charlottetown now knows what kind of a public works department Montreal has. What was arranged in this case would be done much more frequently between cities who are members of the same union.

All of the foregoing shows very clearly the need of the bureau or clearing house for information which it is proposed to establish in connection with this union. Not only can the experience of one Quebec city be made available, in fact be reported to all the other Quebec cities, but, if the organization falls into very active hands, much valuable information can be secured from the outside municipalities and supplied to the proper official in each of the Quebec municipalities. Such a bureau need not wait until it is requested for information which some city finds it needs; it can go out into the highways and byways and seek out information which will be of benefit to its member cities but of which they do not happen to have even heard.

While we do not all want to be alike, economy and efficiency certainly demand that we do be alike in most things where there is no good reason, practical or artistic, for being different. Some advantage will accrue from a sort of interchangeability of parts, even to municipalities; and I think much can be done by this union towards a sane amount of standardization.

Standardization of Municipal Equipment

If three cities are using different models of a given machine which each is building or buying, why should not the representatives of these three cities get together, decide, if they can, which machine is the best, or possibly design a new one which will be a composite of the three and superior to all, and adopt that as a standard until something new develops? The street railways of North America have standardized the rails they use, for instance; and it is standardization like this which I have in mind. Such standardization might also be made to operate in favor of Canadian manufacturers, whenever possible, without appreciable loss to the cities.

Just now, the commission-manager form of government, with proportional representation, has the centre of the municipal stage. My study of the subject finds me very much in favor of this type of machinery for city government; but I would very much like to know what a committee appointed by the Union of Quebec Municipalities, from among their own members, would say about it. After careful study, this committee would either recommend this type of commission-manager charter for Quebec municipalities, would offer some improvement upon or amendment thereof, or would reject it as not so satisfactory for Quebec as the present type of charters. At least, we would get action upon such a matter; and it would not be left for a few public-spirited men to spend their lives going from one city to another recommending this change.

There are, of course, a certain number of persons and interests in every community who prefer things-as-they-are. Some of these folk are just too lazy to move in a new direction; others are securing special privileges under the present order and fear they may lose them during the change. There are a certain number of business firms selling to cities, a certain number of contractors doing business with cities, who do not want any bureau of information which may tell their customer cities how badly they are being over-reached. The job holders who do not want any new-fangled ideas which will mean more work may also be relied upon to speak against any such innovation as a municipal union which means business; but I am confident that most municipal employees will respond to the call for more efficient organization with alacrity.

As far as the firm of which I am a member is concerned, we believe the formation of this union can produce nothing but good for us, for we think it will mean a greater appreciation on the part of the member municipalities of the value of the kind of work we do. Moreover, if the day ever comes when the union thinks it necessary to municipalize us, or any part of us, and a workable plan is forthcoming, there will be no opposition on my part. I believe in municipal ownership up to the hilt; a municipally owned municipal league and all that may logically grow out of it.

Representatives of the Dominion and Manitoba governments conferred last week with delegates from the United States, who visited Winnipeg, on the problem of prevention of floods in the Red river valley. Large areas of Manitoba, Minnesota and North Dakota are flooded every spring from that river's overflow, and seeding operations are delayed. Schemes were suggested which the United States representatives declared would mean a saving of $100,000,000 during the next thirty years.

J. G. Sullivan, formerly chief engineer for the C.P.R.; J. C. Holden, C.P.R. district engineer; B. Stewart McKenzie, consulting engineer; and W. P. Brereton, city engineer, all of Winnipeg, Man., have advised the Greater Winnipeg Water Board that in order to prevent gradual disintegration of the Shoal lake aqueduct, it is necessary to underdrain the section in which the conduit is exposed to the action of water heavily charged with alkali. John Woodman, consulting engineer, disagreed and gave his opinion that the aqueduct is quite safe from alkali action. The engineers had been called in by the board to express their opinions as to what should be done in connection with an underdrainage scheme submitted by Chief Engineer Chace and which will involve an expenditure of from $300,000 to $400,000.

Speaking at the evening session of the United Farmers' convention, December 17th, at Massey Hall, Toronto, Hon. Mr. Biggs, Ontario minister of public works, said that the government proposes to abolish statute labor. He suggested aid for township roads, using the revenue received from auto licenses for this purpose, and giving special consideration to the poorer townships which are not in a position to help themselves, by setting aside $2,000,000 for loans to them, repayable in five-years without interest. Mr. Biggs stated that the federal government has allotted $6,000,000 to the province of Ontario for provincial highways, and he thought that the Ontario government should avail itself of the full amount and "construct 1,600 miles of provincial county roads." "I would say," he continued, "that we do not intend to build any hard-surface roads at any place, unless the cost of building them is less than a macadam road."

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HAPPY NEW YEAR!

NEXT Thursday will be the happiest New Year's Day that Canada has experienced in half a decade. That the war has been conclusively settled is now beyond doubt, and equally certain is it that the troubles of the reconstruction period are being rapidly overcome. The new year will be a very busy one in engineering circles. There will undoubtedly be satisfactory employment for every engineer and plenty of profitable business for all engineering firms. Let's go! Let's produce! Make the wheels hum in 1920! Happy New Year!

MORE FLUSHING, LESS DISEASE

WHEN suddenly enveloped in a whirling cloud of dust from dirty, unflushed pavements, we encounter a positive danger almost as deadly in its possibilities as a gas attack. What we are possibly too accustomed to regard as an unavoidable annoyance has been demonstrated by scientists to be one of the gravest causes of some of the most deadly diseases that affect mankind,—those of the respiratory organs.

Pneumonia alone has an enormous yearly death-rate in this country. The fact that pneumonia germs can live for a considerable time in dust is well known, but apparently little thought has been given to the extreme danger of communicating this disease by means of the dust thus infected. Dr. Rufus Cole, of the Rockefeller Institute, says: "We have been so interested in better water supplies, better sewerage systems, etc., that we have forgotten the importance of dust in spreading infection, especially in spreading the acute respiratory diseases which now cause more deaths than all the other acute communicable diseases combined."

This reminder is a good one for all municipal engineers and street superintendents to ponder, for it is to them that the public must look for adequate protection from the dangers of unlaid dust. Typhoid has been practically conquered by municipal engineers; they should now give earnest attention to the dust evil, and, by making arrangements for thorough flushing, add one more to their long list of public benefactions.

SALARY SCHEDULE FOR HIGHWAY ENGINEERS

AT the convention of the American Association of State Highway Officials, held this month in Louisville, Ky., a resolution was passed endorsing a list of recommended salaries for engineers in state highway service. This list had been prepared by a committee of the American Association of Engineers.

A. N. Johnson, consulting highway engineer of the Portland Cement Association, who was chairman of the American Association's committee, in addressing the convention stated that the recommended salaries had been established by first selecting three places in the schedule: The highest, the middle position, and the lowest.

The highest position was that of the chief engineer of the state highway department. The middle position was "considered to be one requiring an engineer having at least four or five years' experience since graduation from college,—a man who, it may be expected, will be married. Such a position should, therefore, carry with it a salary to enable a young engineer with a small family to live in comfortable and appropriate surroundings. The lowest position was established as one filled by a recent graduate.

"The salaries established for these three positions are $8,000 to $15,000 for the highest; $3,600 to $5,000 for the middle position; and $1,200 to $1,500 for the lowest.

"If practical results are to follow suggestions regarding salaries of engineers in public service or in any other service," said Mr. Johnson, "the first essential is unity of opinion and purpose amongst engineers themselves. One of the chief drawbacks to higher salaries for engineers in public service has been, in the past, the opposition of these very engineers themselves. This may seem at first paradoxical, but here is an instance: A legislative committee gives a hearing on the subject of salary increases for a a certain position and behold, there appears before the committee a number of engineers who state that even lower salaries than those paid at present are paid to engineers, and that engineers may be easily secured for the present salaries. What is a legislator to think?"

CENTRAL ELECTRIC STATIONS IN CANADA

EARLY this year announcement was made of the intention of the Dominion Bureau of Statistics to publish a volume of statistics obtained by a census of the central electric power stations in Canada. At the same time it was stated that the Dominion Water Power Branch, working in co-operation with the Dominion Bureau of Statistics, would publish a directory of the stations.

Both of these volumes are now ready for distribution. The census statistics, in French and English, fill a volume of about eighty pages, 6½ by 9¾ ins. The directory is a volume of 252 pages of the same size, and includes a large folded map showing the location of the stations.

For copies of the statistics volume, applications should be made to R. H. Coats, Dominion Statistician, Ottawa. For copies of the directory of central stations, applications should be made to J. B. Challies, Director of Water Power, Ottawa.

It was unanimously resolved at a meeting held in Toronto to discuss compulsory vaccination, that the provincial government be petitioned to enact legislation whereby sanitary engineers should be substituted for the present medical officers of health, and to make illegal the appointment to that office of any practitioner of any system of medicine.

PERSONALS

W. A. SIBBETT, of Bracebridge, Ont., has sailed for South America, where he has been employed by the Columbian government to survey the Barranquilla Harbor and to plan extensive water-front improvements. Mr. Sibbett was born November 4th, 1890, in Bracebridge, Ont., and was educated at Barrie Collegiate and the University of Toronto, where he graduated with honors in civil engineering with the class of 1911. He joined the staff of W. H. Fairchild, of Brantford, Ont., in order to study for the O.L.S. degree, and in 1912 he passed the necessary examinations. The following two years were spent with Mr. Fairchild in surveying and municipal work, and Mr. Sibbett was then appointed surveyor of the North Bay division of the C.P.R. In January, 1915, he joined a staff of engineers who were surveying harbors in British Columbia for the Dominion government, but in December, 1915, he resigned this position and enlisted as a private in the 122nd Muskoka Battalion, although he obtained a commission before he went overseas in April, 1917. While waiting to be sent overseas, Mr. Sibbett studied for the D.L.S. examinations, obtaining that degree in 1916. The military unit to which Mr. Sibbett was attached was sent directly from Canada to France, and there he was promoted to the rank of captain, and in April, 1918, he was transferred to the headquarters' engineering staff of the Canadian Forestry Corps. Last January he returned to Canada and obtained a provincial government survey contract for work in Northern Ontario, which contract he had just completed when he was recommended to, and accepted by, the Columbian government for the work above mentioned. Mr. Sibbett's present address is c/o Pinedo, Weeber & Co., Barranquilla, Colombia, South America.

GEORGE J. GUY, chairman of the Hamilton Harbor Commission, has been appointed vice-chairman of the Canadian Deep Waterways and Power Association.

HENRY HYMMEN, who has been water works superintendent of Kitchener, Ont., for the past 19 years, has resigned in order to take charge of the plant of the Dominion Products Co., Guelph, Ont.

J. CAMPBELL BRADY, of the British Columbia public works department, has been promoted to the rank of district engineer and will be in charge of No. 6 district, with jurisdiction over Cranbrook, Fernie and Columbia ridings.

LEWIE D. WALKER has been appointed water works engineer and inspector for the Canadian Fire Underwriters' Association, Toronto. Mr. Walker returned from overseas last March and joined the engineering staff of the British-American Nickel Corporation, at Deschenes, Que. Before going overseas he was employed at Sault Ste. Marie, Ont., in dock construction for the Department of Public Works of Canada.

W. BLAZER, civil engineer of the Government Service for Water Power and Electricity, Dutch East Indies, and whose headquarters are at Bandoeng, Java, is visiting Canada and the United States under a commission from the Netherlands' government to study water power stations. It is understood that the water power potentialities in the islands of the Dutch East Indies total several million horsepower. The government has developed and is operating several plants generating power for railway shops, etc., there are over three hundred private water power plants for plantations and other industries, and the government is pursuing an active development policy. Mr. Blazer intends also to visit Switzerland.

OBITUARY

JOHN DOBSON, for many years the senior member of the firm of Dobson & Jackson, contractors, Winnipeg, died in that city December 15th.

ROAD CONSTRUCTION IN BRITISH COLUMBIA

SPEAKING of the development of roads in British Columbia, J. Campbell Brady, a district engineer with the provincial public works department, said that the intention for the coming season is to improve and complete the road from Windermere to Cranbrook, making it come up to the standard of the Banff-Windermere highway, which the Dominion government recently took over and proposes to finish as an auto highway within the next two years. When these roads are completed, it will be possible to drive on a hard-surfaced road through Cranbrook to Spokane, via Yakh and Kingsgate.

From Golden to Windermere is approximately eighty miles, and most of this highway is in very fair condition. Twelve miles before Windermere is reached is the point at which the Banff-Windermere road converges. This road, which has only been partly developed by the provincial government and by the Canadian Pacific railway, now becomes a part of the Dominion government's park system.

A zone of five miles wide on each side of the highway has been set apart as a park area. At the Columbia, or Radium, hot springs, two miles from the junction of the Banff-Windermere highway with the road from Golden, there is every likelihood of a new tourist resort being established.

The annual meeting of the Ontario Good Roads Association will be held in Toronto March 3rd to 5th, 1920. The Ontario county roads superintendents will also convene at Toronto March 1st to 3rd.

In a speech at Brockville, Ont., Hon. F. C. Biggs, minister of public works for Ontario, dealt with the road system in that province. He said that the government hopes to add materially to it, and that instead of being 500 miles in length, the provincial highway should be 1,500 miles, touching every country. Unless this could be done to some extent, opposition to trunk roads will develop. He stated his belief that the provincial highway is the best advertising medium that Ontario has, and he strongly advocated further help from the government for the townships in road construction, and urged the appointment of permanent township road superintendents. Rural depopulation, said the minister, could be offset by good roads, improved rural schools, and the "Hydro."

Representing practically every municipality east of Kingston, a deputation waited on the Ontario government recently and requested that the Hydro-Electric Power Commission be instructed to proceed with the development of power at Chats Falls, Ont., and also with the development of the St. Lawrence river, in order that electric power may be furnished to industries which now wish to establish manufacturing plants in the eastern section of the province. W. E. Smallfield, chairman of the Utilities Commission of Renfrew, Ont., stated that 120,000 to 150,000 h.p. could be developed at Chats Falls, which is 30 miles from Ottawa, at a cost of from $5,000,000 to $8,000,000. This development, he claimed, could be undertaken at once, whereas it might take ten to fifteen years to get power from the St. Lawrence river.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand or proposed, contracts awarded, changes in staffs, etc.

ADDITIONAL TENDERS PENDING

Not Including Those Reported in This Issue

Further information may be had from the issues of *The Canadian Engineer*, to which reference is made.

PLACE OF WORK	TENDERS CLOSE	ISSUE OF	PAGE
Banff, Alta., construction of bridge	Jan. 7.	Dec. 4.	45
Canwood, Sask., erection of school	Jan. 1.	Dec. 11.	48
Finch, Ont., road construction	Jan. 19.	Dec. 4.	45
Halifax, N.S., bridge construction	Jan. 5.	Dec. 11.	45
Kitchener, Ont., erection of factory addition	Dec. 31.	Dec. 18.	50
New Westminster, B.C., construction of dam, embankment and three groynes	Jan. 7.	Dec. 18.	52
St. Thomas, Ont., electric and gasoline auxiliary pumping equipment	Dec. 30.	Dec. 18.	54
Toronto, Ont., survey posts	Jan. 15.	Dec. 18.	54
Toronto, Ont., centrifugal pumps	Feb. 10.	Dec. 18.	54
Vancouver, B.C., dredging and filling work	Dec. 29.	Dec. 11.	54
Windsor, Ont., erection of theatre	Jan. 1.	Dec. 18.	52
York Tp., Ont., cast-iron pipe, cast-iron specials, gate valves, hydrants and cast-iron valve covers and frames	Jan. 17.	Dec. 11.	54

BRIDGES, ROADS AND STREETS

Brampton, Ont.—Warren Bituminous Paving Co. of Ontario, Toronto, have contract for paving for town.

Edmonton, Alta.—Plans for a large, new suburban park on Big Lake, near here, include the construction of 10 miles of 30-ft. roadway. J. R. McIntosh is the promoter of the scheme.

Enderby, B.C.—Contract let by Provincial Department of Public Works to Robert Moncrieff, Kent Hotel, Victoria, for erection of $16,400 bridge.

Erickson, B.C.—Contract was not let by the Provincial Department of Public Works for the construction of a highway bridge over the Goat River, near Erickson, for which tenders closed November 25th, the department deciding to do the work by day labor.

Lac du Bonnet, Man.—Municipal council plans construction and improvement of public roads at cost of $50,000. Secretary-treasurer, W. D. Halliday.

Ontario County, Ont.—County council plans erection of several bridges. Road superintendent, R. R. Mowbray, Whitby, Ont.

Ottawa, Ont.—A by-law to have some 30 miles of county roads designated as provincial county highways was passed by Carleton county council.

Ottawa, Ont.—Carleton county council passed a resolution, asking the Department of Highways to construct the provincial county highway from Ottawa, via North Gower, to Ashton, where it will link up with the present county system of Lanark and run to Smith's Falls, via Prospect and Franktown. Lanark county council also recommended the construction of this highway, and it is expected the department will accede to the united request of the two counties.

Quebec, Que.—An important delegation called on Hon. J. A. Tessier, Minister of Roads, composed of representatives from the municipalities of Compton, asking for the construction of a regional route between Cookshire and Beecher Falls. The Minister promised to send an engineer next spring who would make a report on the matter.

Quebec, Que.—Three delegations, all interested in roads, recently called upon Hon. J. A. Tessier, Minister of Roads. The first delegation asked that the road from Laprairie to St. Johns and thence to Lacolle be completed as soon as possible. Another delegation was from the Eastern Townships, and mostly from Mississquoi, and were particularly interested in the proposed road from Lacolle to Knowlton. The third delegation urged the construction of the road on the North Shore, from St. Lambert to Levis. Hon. Mr. Tessier promised all the delegations he would give their request careful consideration.

Simcoe, Ont.—Plans will be prepared by Town Engineer G. R. Marston for erection of five bridges estimated to cost $70,000. By-law will be submitted.

South Hull, Que.—A movement is on foot by the municipal council of South Hull for the construction of a road to Aylmer. Secretary-treasurer, W. H. Stewart.

SEWER TENDER

The Essex Border Utilities Commission will receive proposals until 10 a.m., January 8th, 1920, for building the South Intercepting Sewer, which work includes the excavating for, laying, joining and backfilling approximately 8,483 feet of 27-in., 39-in. and 42in. reinforced concrete pipe now on the work, furnishing material for and building sixteen manholes, the cast-iron covers and steps for which are now on the work.

The work to be done on the basis of actual cost, plus a profit fee on a sliding scale, the lowest, capable, reliable bidder to receive a profit fee of 10% of the estimated cost of the work, this fee to be increased by 25% of any amount by which the actual cost is less than the estimated cost submitted by the contractor, and to be decreased by 10% of any amount by which the actual cost exceeds the contractor's estimated cost.

Each proposal to be accompanied by a certified cheque for $1,000 as a guarantee that in case proposal is accepted the bidder will enter into the contract and furnish bond in form approved by solicitor of Commission that he will complete the work within the time specified and in a manner acceptable to the Commission and protect the Commission against all liabilities.

Plans and specifications of the work are on file at the office of the Commission, 66 Ouellette Avenue, Windsor, Ont., and may be secured on depositing $25,00, which deposit will be refunded in case they are returned in good condition on or before January 15th, 1920. The right is reserved to reject any or all proposals or to accept the one that is for the best interests of the District.

ESSEX BORDER UTILITIES COMMISSION.
GORDON M. McGREGOR, Chairman.
394 W. J. BAXTER, Secretary.

St. Jean de Matha, Que.—Town council will gravel part of the Joliette-St. Emelie Rd. at a cost of $6,255. Secretary, J. O. Leveille.

Sumas, B.C.—Fire damaged the low-trestle bridge over Matsqui prairie, near here, to the extent of $2,000 or $3,000.

Tillsonburg, Ont.—By-law re construction of pavement will be submitted. Town clerk, A. E. Raynes.

Toronto, Ont.—Work will start next spring on the construction of a new roadway in Earlscourt district.

Walkerton, Ont.—Town council plans construction of pavement. Clerk, A. Collins.

Whitby, Ont.—Ontario county council let contract to P. J. Kehoe at $2,125 for rebuilding Scott's Creek bridge.

Whitby, Ont.—Ontario county council plans road improvements and purchase of stone-crushing equipment.

Winnipeg, Man.—Tenders addressed to the chairman, Committee on Works, will be received at the office of C. J. Brown, city clerk, up to 3 o'clock p.m. on Tuesday, December 30th, 1919, for supply of a small batch concrete mixer having a capacity of from 6 to 7 cubic feet per batch. Specification may be obtained at the office of the City Engineer, 223 James Ave.

WATER, SEWAGE AND REFUSE

Brantford, Ont.—Final report on reconstruction of waterworks has been submitted to city council by R. S. and W. S. Lea, engineers, Montreal.

Chatham, Ont.—A by-law will be submitted to the electors in January to decide which waterworks scheme they are in favor of adopting, the Thames River filtration scheme, or the Lake Erie scheme.

Moncton, N.B.—City council let contract to Louis Stephens and Co. for the completion of the main sewer in Block 9.

Moncton, N.B.—City council plans extension of water main from Irishtown Crossing to the new pumping station. City engineer, J. Edington.

Moncton, N.B.—City council let contract for valves to T. McAvity and Sons, Ltd., St. John, N.B., and for 18-inch pipe, necessary to connect the old and new water systems, to the Sumner Co.

Richmond, B.C.—Three schemes for new drainage are being considered by municipal council. Clerk, S. Shepherd.

Richmond, Que.—Tenders addressed to A. V. Glassey, secretary-treasurer, Richmond, Que., will be received up to 12 o'clock noon on Wednesday, December 31st, 1919, for the construction of sewer and water line. Plans and specifications may be seen on application at the town office.

Stratford, Ont.—City council will have a sanitary sewer constructed on the east side of Trinity St. City engineer, A. B. Manson.

Timmins, Ont.—The question of installing a chlorination plant will be taken up by next year's council. Clerk, H. E. Montgomery.

Toronto, Ont.—City council plans to purchase belt conveyer for main sewage disposal station.

Walkerville, Ont.—Contract for the laying of 1,600 feet of sewer on Kildare Rd. awarded by town council to Merlo, Merlo and Ray at $9 a foot. The sewer will lead from the Essex Terminal Ry. to the Tecumseh Rd. It will be of 30-inch concrete pipe.

Winnipeg, Man.—The Manitoba Drainage Commission will take up the question of adopting a system to drain 300,000 acres of land in the southern part of the province at a meeting to be called soon after the New Year. Chairman, J. G. Sullivan, Winnipeg.

Winnipeg, Man.—Tenders addressed to the chairman, Committee on Works, will be received at the office of C. J. Brown, city clerk, up to 3 o'clock p.m. on Tuesday, December 30th, 1919, for the construction of a sewer in Pritchard Ave., from Prince St. eastward to the C.P.R Selkirk branch. Specification may be obtained at the office of the City Engineer, 223 James Ave.

Woodstock, Ont.—By-law to provide $100,000 for construction of an intercepting trunk sewer and sewage disposal plant will be submitted to electors at municipal elections. City clerk, John Morrison.

LIGHT, HEAT AND POWER

Belleville, Ont.—City council will take up with the Hydro-Electric Power Commission of Ontario the question of developing further power in this district from Ranney's Falls.

Elk Lake, Ont.—It is stated that a scheme of power development at Indian Chutes, on the Montreal River, a short distance north of Elk Lake, is projected, and that power will be available by the fall of 1920. It is said that between 4,000 and 5,000 h.p. can be developed.

Galt, Ont.—By-law to raise $30,000 for installing a central heating plant for the Galt General Hospital, the Isolation Hospital, the Maternity Hospital and the new Nurses' Home, and for building an addition to the present laundry and heating plant of the Galt Hospital, will be submitted at municipal elections. Clerk, Joseph McCartney.

Lakefield, Ont.—By-law to authorize the installation of a Hydro-Electric system will be submitted to electors at January election. The total cost of installing the system, which includes the reconstruction of the present distribution plant and its purchase from the local electric light company, etc., is $33,500.

Marmora, Ont.—Town council plans to construct new sub-station and Hydro power distribution system to cost $14,000. By-law may be submitted. Clerk, H. W. Sabine.

Regina, Sask.—The construction of a high transmission power wire from the Regina power plant to Lumsden, Sask., is projected. Address, W. J. Vancise, Lumsden.

Stratford, Ont.—City council passed by-law for the issuing of debentures for extension to the local power station. City clerk, R. R. Lang.

Tara, Ont.—Town council plans extension to Hydro system. Clerk, W. J. Taylor.

Toronto, Ont.—Deputations from municipalities east of Kingston waited upon the Ontario Cabinet, asking that the Hydro-Electric Power Commission of Ontario be instructed to proceed with the development of power at Shaw Falls and the St. Lawrence River; and further, that they be given representation on the Hydro Commission, naming Mayor Lewis, of Brockville. It was stated that approximately 150,000 h.p. could be developed at Shaw Falls, about 30 miles from Ottawa, at a cost of from five to eight million dollars.

Toronto, Ont.—Permission was given the Civic Hydro Commission by the city council to apply to the Ontario Railway Board for authority to raise another $950,000 to provide for needed extensions of the system.

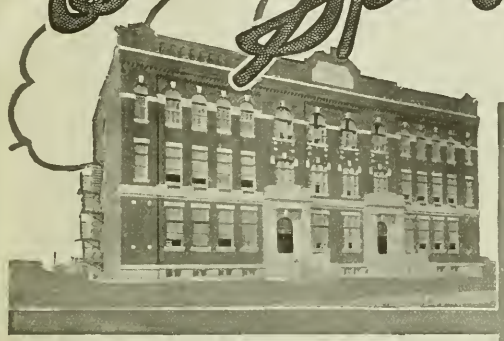
Waterloo, Ont.—The Waterloo Water and Light Commission decided to place an order at once for transformers and other equipment in order to increase the capacity of the plant from 1,200 to 3,000 h.p.

Winnipeg, Man.—Contract for aluminum transmission cables needed for extension of city's power transmission line has been let to the Northern Aluminium Co., Ltd., the amount of contract being approximately $250,000.

Winnipeg, Man.—Contracts have been let for two 5,000-h.p. transformers for installation in the Point du Bois power plant, one to the Canadian General Electric Co. for $33,000 and the other to the Canadian Westinghouse Co. for $35,553.

Winnipeg, Man.—Tenders addressed to the chairman, Committee on Works, will be received at the office of C. J. Brown, city clerk, up to 3 o'clock p.m. on Tuesday, December 30th, 1919, for the supply of 200 lengths of 1½ in. by 14 ft. boiler tubes for steam rollers. Specification may be obtained at the office of the City Engineer, 223 James Ave.

Barrett Specification Roofs



20-Year Barrett Specification Roof on St. Marc's School, Montreal. Owners: Catholic School Board, Montreal. Architects: Vautrin & Bernier, Montreal. Gen. Cont.: Ulric Boileau, Limited, Montreal. Roofers: Canada Roofing & Paving Company, Montreal.

20-Year Barrett Specification Roof on Old Orchard Avenue School, at Notre Dame de Grace. Owners: School Commissioners of Notre Dame de Grace, Montreal. Architects: Audet & Charbonneau, Montreal Roofers: Tremblay & Francoeur, Montreal.

The *modern* way to buy a roof—

When the two school buildings shown above were completed, we handed their owners, the Catholic School Board of Montreal, Surety Bonds which *guarantee* the roofs against trouble or maintenance expense for a period of *20 years*.

The probabilities are that these roofs will last for nearer *30 years* without attention.

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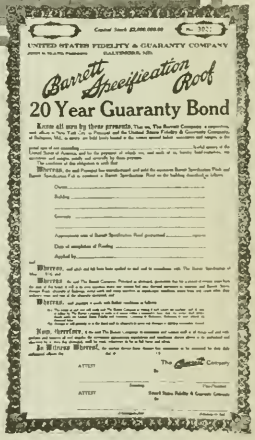
Guarantee 20 Years of Service

Now we offer to go a step further and actually *guarantee* a Barrett Specification Roof *for a period of at least 20 years!*

This guarantee, obtainable on any roof of 50 squares or more, in any town of 25,000 or over, and in smaller places where our Inspection Service is available, is in the form of a Surety Bond, issued by a well-known fidelity company.

To obtain the Bond you have only to insert in your building specifications the following:

"The roof shall be laid according to The Barrett Specification dated May 1, 1916, and the roofing contractor shall secure for me (or us) the 20-Year Guaranty Bond therein mentioned."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20 Year Guaranty Bond

This is the bond that guarantees your roof for twenty years.

The guarantee costs you nothing. We merely require an opportunity to send our Inspectors to watch the job during construction.

You get a roof that will cost less per year of service than any other type of permanent roof, and that takes the base rate of insurance. We get the satisfaction of knowing that our materials are creditably used.

We should be very glad to send you further details and copy of the Barrett 20-Year Specification, with diagrams, ready for insertion in your building plans.

The Barrett Company LIMITED

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ST. JOHN, N.B. HALIFAX, N.S. SYDNEY, N.S.

Winnipeg, Man.—Four tenders have been received for the water turbines needed for the extension to the city's power plant at Point du Bois, these tenders being from the Boving Hydraulic and Engineering Co., Ltd., Canadian Allis-Chalmers Co., Ltd., S. Morgan Smith Co. and Vickers, Ltd. The amounts of these tenders are understood to be in the neighborhood of $200,000.

Winnipeg, Man.—Tenders addressed to the chairman, Committee on Fire, Water, Light and Power, will be received at the office of C. J. Brown, city clerk, up to 3 o'clock p.m. on Monday, December 29th, 1919, for the supply of three 200 k.w. single-phase outside transformers, delivered, f.o.b. cars, Winnipeg, freight and duty paid. Specification may be obtained at the office of the City Light and Power Department, 54 King St.

Winnipeg, Man.—Tenders addressed to the chairman, Committee on Fire, Water, Light and Power, will be received at the office of C. J. Brown, city clerk, up to 3 o'clock p.m. on Monday, December 29th, 1919, for the supply of 1,200 feet of 250,000 G.M. 13,500-volt, 3-core, lead-covered, paper-insulated cable, delivered, f.o.b. cars James St. yard, Winnipeg, freight and duty paid. Specification may be obtained at the office of the City Light and Power Department, 54 King St.

Winnipeg, Man.—Tenders addressed to the chairman, Committee on Fire, Water, Light and Power, will be received at the office of C. J. Brown, city clerk, up to 3 o'clock p.m. on Monday, January 12th, 1920, for the supply and delivery at the power house, Point du Bois, Manitoba, and terminal station, Winnipeg, of a quantity of electrically operated oil switches and switching apparatus. Specification may be obtained at the office of the City Light and Power Department, 54 King St.

Winnipeg, Man.—Tenders addressed to the chairman, Committee on Fire, Water, Light and Power, will be received at the office of C. J. Brown, city clerk, up to 3 o'clock p.m. on Monday, January 26th, 1920, for the supply, delivery and erection on foundations supplied by the corporation in its power house, Point du Bois, of two 3-phase generators for direct connection to double reaction turbines, and for spare parts for same; also for one additional or extension set, ordered, furnished and installed under the same conditions. Specification may be obtained at the office of the City Light and Power Department, 54 King St.

RAILWAYS

Calgary, Alta.—Three plans for the extension of the street railway in North Balmoral and Tuxedo Park are under consideration by city council. The costs of the schemes vary from $14,000 to $20,000 each. City clerk, J. M. Miller.

Darlington Tp., Ont.—Electors endorsed the by-law to guarantee the bonds of the proposed Toronto and Eastern radial. Only Toronto and York township have still to vote on the project. All the other municipalities between Toronto and Bowmanville have voted in favor of the radial.

Hamilton, Ont.—It has been announced that construction work on the Hamilton-Guelph-Elmira Hydro radial line will start next spring, and that the line will be completed and in operation in 1921.

Mount Laurier, Que.—Quebec Colonization Ry. Co. plans construction of new line from Mount Laurier south-west to C.P.R. at or near Maniwaki, and is applying for provincial charter. Attorneys, Dessaulles, Garneau, Desy and Lorrain 86 Notre Dame St. West, Montreal.

New Liskeard, Ont.—Nipissing Central Ry. Co., care of T. and N.O. Ry. Commission, 56 Church St., Toronto, plans construction of railway line from New Liskeard to North Temiskaming, a distance of 17 miles. Chief engineer, S. B. Clement, North Bay.

Quebec, Que.—Board of Trade will urge Federal government to study the practicability of the establishment of a railroad from Quebec to St. Stephen, N.B.

Quebec, Que.—Extension and improvements to street railways planned by Quebec Railway, Light, Heat and Power Co., 229 St. Joseph St.

Regina, Sask.—The addition of another unit to the car barns and a second story on the office building is included in the proposed Regina Street Railway improvements for 1920. The double-tracking of at least a portion of Fifth Ave. is also planned.

Regina, Sask.—A project to extend the street car lines next spring is being considered. City commissioner, L. A. Thornton.

Sarnia, Ont.—Sarnia will shortly commence negotiations to purchase the now privately owned Sarnia street railway system.

Swift Current, Sask.—Deputations from the Swift Current district recently interviewed D. C. Coleman, vice-president and general manager of the C.P.R. at Regina, requesting the construction of a railway line from Dunelm, on the Vanguard branch, to Instow, on the Weyburn-Lethbridge line; also a line through the Vermilion Hills from Swift Current to a point near Moose Jaw.

Winnipeg, Man.—The Canadian Pacific Ry. have made preliminary arrangements for building a railway line into The Pas district, which would ultimately mean the erection of a railway by that concern into the Copper Lake and Lake Athapupouskou gold district.

York Tp., Ont—On January 17th, 1920, the ratepayers will vote on the by-law for the construction of the new radial line from Toronto to Bowmanville. The total cost of the new radial, it is estimated, will be $8,360,794, and the amount to be borne by York township is $381,587.

FACTORIES AND LARGE BUILDINGS

Aurora, Ont.—G.W.V.A. plan erection of clubhouse.

Bagot, Man.—Tenders will be received up to January 1st, 1920, for remodelling Hartford School (S.D. No. 896), 4½ miles south of Bagot. Plans and specifications may be secured by applying to Geo. Richards, secretary, Bagot P.O., Man.

Bowmanville, Ont.—G.W.V.A. plan clubhouse. Address, Alderman Fisher.

Brampton, Ont.—Contract let to Blatz Bros., 187 Charlton Ave East, Hamilton, for building costing $25,000 for Universal Batteries, Ltd.

Calgary, Alta.—Hon. Geo. P. Smith, Provincial Minister of Education, announced that the preliminary draft of the plans in connection with the new Technical Institute to be erected here is nearly completed. It is anticipated that good progress will be made with the building next spring.

Cap de la Madeleine, Que.—J. A. Rousseau, Ste. Anne de la Perade, plans erection of sawmill. Estimated cost, $100,000.

Chatham, Ont.—Dominion Department Public Works plans extension to post-office. Secretary, R. C. Desrochers, Ottawa.

Dartmouth, N.S.—Work will start at once on erection of rink for the Red Sox A.A.A.

Drummondville, Que.—School building destroyed by fire.

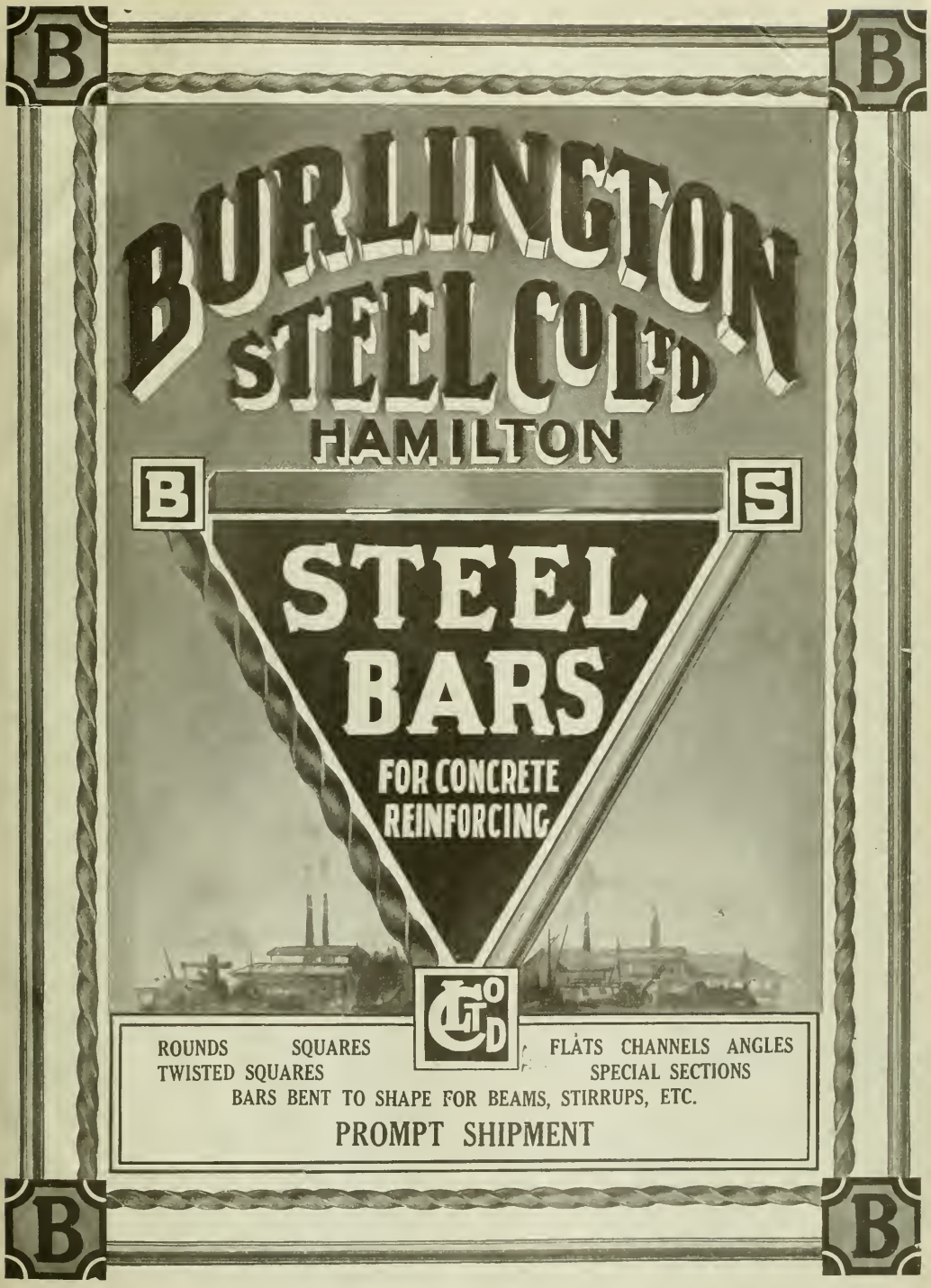
Dundas, Ont.—Canada Crushed Stone Corporation will rebuild roundhouse destroyed by fire. Secretary-treasurer, J. B. Harte.

Flaxcombe, Sask.—Contract let to R. N. Wyatt, Winnipeg, for bank costing $6,000 for Merchants Bank of Canada

Fredericton, N.B.—Members of Christ Church Cathedral plan erection of a Memorial Hall and Chapter House on Church St.

Galt, Ont.—Galt Knitting Co. plans erection of new office building. Work will start in spring.

Gananoque, Ont.—Gananoque Canoe and Motorboat Club plan addition to clubhouse.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PROMPT SHIPMENT

Glace Bay, N.S.—The erection of a $30,000 rink is projected here.

Goulburn Tp., Ont.—By-law to borrow $7,000 for the purchase of site and erection of town hall will be submitted to electors at municipal elections. Clerk, J. A. Cummings, Stittsville, Ont.

Guelph, Ont.—The value of building permits issued during the month of November reached $20,325. This brings the total for the year, up to the end of last month, to $599,144, the best year Guelph has had for some time.

Halifax, N.S.—The warehouse building of the Maritime Telephone and Telegraph Co. was damaged by fire to extent of from $100,000 to $150,000.

Hamilton, Ont.—The erection of an office building on Main St. East is planned by Doctors Mowbray and McGregor.

Holdfast, Sask.—Members of Roman Catholic Church plan erection next spring of new church at cost of $35,000. Address, Rev. B. Ueberberg.

Hull, Que.—Dominion Fertilizer Co. will erect a factory in West Hull.

Indian Head, Sask.—Orangemen plan erection of Orphanage.

Irvine, Alta.—The brick schoolhouse at Irvine has been totally destroyed by fire.

Kitchener, Ont.—Plans for erection of new hotel have been prepared by F. A. Baker, Toronto.

Levis, Que.—Erection of a new school is being taken up by School Commission. Address, F. X. Gosselin.

Levis, Que.—Municipal building destroyed by fire with loss of $15,000. City clerk, Lionel Lemieux.

Liverpool, N.S.—MacLeod Pulp Co. plan extension to mill.

Lougheed, Alta.—Contract let to Gee and Nash, Killam, Alta., for bank costing $10,000 for Bank of Montreal.

Midland, Ont.—The Copeland Shoepack Co. proposes to build a factory on Bay St. West., and have asked for a loan of $15,000 from the town, to authorize which a by-law will be submitted to the electors.

Mimico, Ont.—Building permits for the past twelve months, ending December, show a total value of $543,960.

Moncton, N.B.—The possibilities of Moncton or vicinity for the establishment of an aerodrome and training school for aviation are being looked into by Mr. Stevenson, of Truro, N.S.

Montmagny, Que.—Contract let to Beaumont and Boulanger for addition to factory for Agricultural Machinery, Ltd. Estimated cost, $30,000.

Montreal, Que.—Contract let to James Shearer Co., 225 St. Patrick St., for warehouse costing $32,000 for Barrett Co. 2021 St. Hubert St.

Montreal, Que.—During November building permits totalled $890,864, an increase of $714,819. For the eleven months the total was $9,375,500, a gain of $4,491,824.

Montreal, Que.—McClary Manufacturing Co., 23 Wellington St., plan addition to plant.

Montreal, Que.—Henry Birks and Sons, Ltd., plan erection of a ten-story Birks Craft Shop at the south-west corner of St. Monique and Cathcart Sts.

New Toronto, Ont.—The Goodyear Tire and Rubber Co. plans erection of more factory buildings in the immediate future.

New Westminster, B.C.—Plans have been prepared by John Kyle, organizer of technical education, Victoria, B.C., for the reconstruction of the provincial jail building into a technical high school. By-law to authorize expenditure will be submitted to electors at municipal elections. Estimated cost, $25,000.

Niagara Falls, Ont.—Work has started on erection of new Technical School, estimated to cost $125,000.

Oakville, Ont.—Contract let to Chas. F. Till, 103 Bay St., Toronto, for erection of school. Estimated cost, $22,000.

Oshawa, Ont.—Board of Education considering erection of new school on Centre St. next year.

Ottawa, Ont.—Thos. McLaughlin, 574 Somerset St., plans erection of plant to cost $550,000.

Paradise, Nfld.—A. W. Carrick, 87 Glen Rd., will rebuild manufacturing building damaged by fire to extent of $15,000.

Paris, Ont.—Council gave second reading to a $25,000 by-law for erection of new school in the North Ward. Clerk, Thos. McCosh.

Pembroke, Ont.—A by-law to enlarge market building will be submitted to electors in January. Clerk, A. J. Fortier.

Penticton, B.C.—Bank of Montreal plans erection of $25,000 addition to building. Architect, Mr. Bell, Vernon, B.C.

Peterboro', Ont.—C.P.R. and G.T.R. plan erection of Union Station here. Superintendent, Mr. Humphrey, 506 Union Station, Toronto.

Peterboro', Ont.—City council proposes to aid the establishment here of the Canadian Aladdin Co. by granting them a free site on the Monaghan Rd. and other concessions. A by-law to this effect will be submitted to the ratepayers on January 1st.

Peterboro', Ont.—Permit issued to A. McDonald Lumber Co. for erection of a factory at a cost of $2,000.

Point Grey, B.C.—Erection of community building and memorial is planned. Address, Capt. C. Carmichael.

Port Haney, B.C.—School Board plans erection of six-room school at cost of $28,000. Secretary, Mr. Platt.

Quebec, Que.—The largest pulp and paper mill in the world will be constructed by Price Bros. and Co. in the Saguenay district, with a daily capacity of between 400 and 500 tons of newsprint. The creation of a town of Saguenay is involved, to be located three or four miles east of Chicoutimi. Work has already commenced on the Hydro power plant on the Saguenay, and the erection of the paper mill will be commenced in the early part of next year's building season.

Regina, Sask.—Erection of two new public schools is projected.

Regina, Sask.—City council plans erection of municipal boathouse. City clerk, George Beach.

Regina, Sask.—An $18,000 addition will be made to the General Hospital next spring. Address, Andrew MacBeth.

Sarnia, Ont.—Fire damaged plant of Covered Metal Corporation to extent of $25,000.

Sarnia, Ont.—A number of by-laws will be submitted to the electors early in January in connection with the proposed plants to be erected here by the Lake Huron Steel Corporation and the Willys-Lee Auto Corporation.

Sault Ste. Marie, Ont.—It is rumored that the Algoma Steel Co. may erect an extension to its plant at a cost of $6,000,000 or $7,000,000.

Smith's Falls, Ont.—By-law to grant certain concessions, including a free factory site, to the Canadian Cooperage Co., Ltd., will be submitted to electors on January 5th.

Smith's Falls, Ont.—By-law to authorize the issue and sale of debentures for the sum of $25,000 to erect and equip a new fire hall on Church St. and to purchase a new combination pumping engine, chemical engine and hose car will be submitted to ratepayers on January 5th. Clerk, James A. Lewis.

St. John, N.B.—Erection of new courthouse is planned. Clerk, H. E. Wardroper.

Ste. Therese, Que.—Contract let to Cook and Leitch, 55 St. Francois Xavier St., Montreal, for alterations to bank for Molsons Bank.

St. Thomas, Ont.—Contract for erection of mausoleum in Lakeview Cemetery awarded to O. M. Trano, of the Canada Mausoleum, Ltd., Toronto, who will shortly start work.

St. Thomas, Ont.—Contracts in connection with the erection of the new school in the Wilson Ave. district have been awarded as follows: Mason work, James Belbin, $18,460; carpenter work, roofing and slate work, Albert Morris, $21,-

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370; metal work, G. T. Stewart, $2,340; plumbing, Charles Bull, $2,480. Contracts for the heating, ventilation, plastering and electric work have not yet been let. Architect, N. R. Darrach.

Sudbury, Ont.—The establishment of an aerodrome here is projected.

Summerland, B.C.—The hospital here was totally destroyed by fire recently. The loss is $12,000.

Tisdale, Sask.—Contract let to R. N. Wyatt, 15 Canora St., Winnipeg, for erection of bank for Merchants Bank of Canada. Estimated cost, $15,000.

Toronto, Ont.—Movement is on foot by Fairbanks Ratepayers' Association for erection of fire hall.

Toronto, Ont.—Henry Winnett, proprietor Queen's Hotel, Front St. West, plans erection of addition to building.

Toronto, Ont.—General Builders Corporation, 606 Kent Building, plan erection of warehouse costing $200,000.

Toronto, Ont.—The Masonic Hall Co. plans extension of Eglinton Masonic Hall at Yonge St. and Eglinton Ave., North Toronto.

Toronto, Ont.—Contract let to L. E. Dowling, 167 Yonge St., for erection of factory for Murray Printing Co. Estimated cost, $150,000.

Toronto, Ont.—Fire damaged the Dominion Glass Co.'s storage warehouse and storeroom, Dovercourt Rd. and King St., to extent of $100,000.

Toronto, Ont.—Permit issued to A. Shradner and Son for alterations to building at 334 King St. East, near Parliament St., at cost of $5,800.

Toronto, Ont.—Mayor Church announced that a portion of the old Bay St. fire hall will likely be converted into an office for the Industrial Commissioner's staff.

Toronto, Ont.—W. B. Charlton, 217 Grenadier Rd., has general contract and will let sub-trades for warehouse and garage costing $20,000 for W. Walker and Son, Ltd., 1228 Yonge St.

Toronto, Ont.—The expenditure of approximately $2,000,000 within the next year or so on the erection of six new buildings in connection with the University of Toronto is projected. President, Sir Robert Falconer.

Toronto, Ont.—Following permits have been granted: T. Eaton Co., Ltd., one-story metal-clad storage warehouse, west side Spadina Ave., near Front St., $25,913; Chas. M. Parsons and Sons, addition to warehouse, 79 Front St., $11,000.

Toronto, Ont.—Board of Control received a request from the directors of St. Michael's Hospital for a grant of $100,000 toward a new building on Victoria St. in rear of the present hospital. The proposal is to expend $500,000 on the new extension.

Toronto, Ont.—Blatz Bros., contractors, of Hamilton, have commenced work on the erection of a two-story factory for the Masurvey Battery Co., south of Queen St. The building is to be a brick structure, and when completed will cost about $30,000. The work is being superintended by Alex. Carrington.

Toronto, Ont.—Following permits have been issued: Dominion Bank, three-story brick and stone building, Bay St., south-west corner Queen St., $135,000; James D. Ray, two-story brick factory, 105-107 Sherbourne St., $15,000; F. Quideman, one-story brick public garage, 262-264 Parliament St., $6,000; Lake Simcoe Ice Co., ice plant, west side of George St., $35,000.

Unionville, Ont.—Electors of Markham township will vote on a by-law for the erection of a community hall in Unionville. Estimated cost, $15,000. Clerk, G. A. M. Davison, Unionville.

Vancouver, B.C.—Plans are under way for the erection of a new cattle barn at Hastings Park to cost approximately $30,000. City clerk, W. McQueen.

Vancouver, B.C.—By-law to provide the necessary money for the erection of a bathhouse at English Bay will be submitted to the electors next spring. Chairman Park Commissioners, J. Rogers.

Vancouver, B.C.—Permit issued to W. E. Drake for repairs to Sterling Hotel costing $7,000, which was recently damaged by fire.

Vancouver, B.C.—Contract let to W. A. McPhalen, 2422 Carolina St., for alteration of woollen mill at cost of $35,000 for Canada Western Woollen Mills, Ltd.

Vellore, Ont.—Vaughan township council will erect a memorial hall at Vellore if the ratepayers approve of the plan. Approximate cost, between $7,000 and $8,000. Clerk, J. B. McLean, Maple, Ont.

Victoria, B.C.—New theatres of magnificent proportions will be erected next year in Victoria and Vancouver by the Transcanada Theatres, Ltd. H. W. Beauclerk, care of Bank of Montreal, Montreal, is head of the company.

Victoria, B.C.—The lumber mill of Moore and Whittington was destroyed by fire. Loss, $90,000.

Welland, Ont.—Welland county council decided to construct a county memorial building in Welland.

Westmount, Que.—Merchants Bank of Canada, 202 St. James St., plan erection of branch bank. General manager, D. C. Macarow.

Wheatley, Ont.—Town plans erection of community hall to cost $7,000. By-law may be submitted. Clerk, J. W Kennedy.

Windsor, Ont.—Fire destroyed the Lakeview Hotel. Loss, over $15,000. Proprietor, Fred. Kirche.

Windsor, Ont.—Albert Kahn, architect, Marquette Building, Detroit, is preparing plans for reinforced concrete factory and power-house costing $250,000 for the Burroughs Adding Machine Co.

Winnipeg, Man.—A movement is on foot for erection of new market building on Market Square. Address, Reeve A. Todd, St. Vital, Man.

Winnipeg, Man.—According to W. J. May, director of hotel accommodations for the province, several hotels will be erected in different parts of Manitoba next summer.

Woodville, Ont.—Knox Presbyterian Church was totally destroyed by fire last week. Loss, $30,000.

York Tp., Ont.—Application has been made at the office of the York township building inspector for permits for the building of two new schools in the Fairbank district to cost $100,000 each. Excavations have already been started and the buildings will be ready for next summer. One will be known as the Fairbank Memorial School, and will be located on Harvie Ave., south of Eglinton, and the other, the John R. Wilcox School, will be located on the western border of the Cedarvale estate, north of Vaughan Rd.

MISCELLANEOUS

East Gwillimbury Tp., Ont.—Township council approved the scheme of the A. James Co., Ltd., Toronto, to reclaim 4,000 acres of the Holland Marsh at a cost of $60,000. Work will start as soon as possible. If the scheme is practicable, the whole of the 90,000 acres of waste land around the Holland River will be drained. Clerk, A. R. McKenzie, Queensville, Ont.

Hamilton, Ont.—The Harbor Commissioners will urge the Department of Public Works to proceed with plans for widening and deepening the Beach canal next spring.

Lac Mekinac, Que.—Construction of $50,000 concrete dam is planned by Quebec Streams Commission, 59 Notre Dame St. East, Montreal.

Maple Ridge, B.C.—Steps are being taken toward dredging a canal to unite the waters of the north and south branches of the Lillooet River. Clerk, D. C. Webber.

New Glasgow, N.S.—The Nova Scotia Steel and Coal Co. has acquired for $2,000,000 a controlling interest in the

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C.E.—25-12-19

Acadia Coal Co., formerly operated by a Belgian syndicate, with head offices in Brussels.

Ottawa, Ont.—Among companies recently incorporated are the following: Republic Flow Meter Co. of Canada, Ltd., Toronto, $50,000; Bird Machine Co., Ltd., Toronto; Manitoba Clays and Building Supplies, Ltd., Winnipeg, $300,000.

Ottawa, Ont.—Tenders addressed to G. J. Desbarats, Deputy Minister of the Naval Service, Ottawa, Ont., will be received up to noon of Friday, January 2nd, 1920, for the construction of three first-class single-screw tugs of approximately the following leading dimensions, namely: Length between perpendiculars, 75 ft.; breadth, moulded, 17 ft. 6 in.; depth, moulded, 9 ft., to be delivered at Port Stanley or Kingsville, Ont. Descriptive specifications may be obtained on application to G. J. Desbarats.

Owen Sound, Ont.—Contract let by Dominion Department Public Works to N. B. Horton, of Owen Sound, for erection of concrete dock on east side of harbor. Approximate cost, $86,000.

Three Rivers, Que.—Harbor Commission, Post-office Building, plans construction of $50,000 wharf.

Toronto, Ont.—The Harbor Commissioners approved the programme of work to be carried out next year, which calls for an expenditure of approximately $4,000,000. The work includes completion of the Sunnyside boulevard scheme, establishment of large amusement park at Sunnyside, erection of large bathhouse, construction of sea-wall in front of the Exhibition grounds and pier-heads between York and Cherry Sts., erection of large warehouse building near foot of York St. and development of the eastern lake front to correspond with the improvements in the Sunnyside district. In connection with the last item, city council has passed a by-law for the acquisition by the city of all privately owned water lots in the Beaches to enable the Commission to carry out this work. General manager, E. L. Cousins.

Victoria, B.C.—The following are among new companies recently incorporated: Salmon River Silver Mines, Ltd., Victoria, $50,000; Canadian Lignite Co., Ltd., Victoria, $90,000; President Silver Mines, Ltd., Vancouver, $100,000; Vancouver Sheet Metal Co., Ltd., Vancouver, $5,000.

Winnipeg, Man.—Improvements to cost $133,000 to increase the daily output to 1,000 cubic yards of gravel from the Greater Winnipeg Water District pit have been decided upon by the commissioners of the District. The improvements include enlargement of present plant, purchase of extra railway dump cars and five motor trucks. Chief engineer, W. G. Chace.

York Tp., Ont.—Township council is issuing bonds totalling $562,564.68 for local improvements, public school purposes and waterworks.

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